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Innovative Treaty Sensor Integration Project (ITSIP)

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13. ABSTRACT *(Maximum 200 words)*

This report presents the results of the requirements analysis and system architecture, system fabrication, and Proof-of-Principle demonstration and evaluation of the Innovative Treaty Sensor Integration Project (ITSIP) for the Defense Nuclear Agency. ITSIP's objective was to demonstrate the utility of advanced information technology, sensor integration, and artificial Intelligence to arms control treaty monitoring and verification scenarios.

A START Treaty portal monitoring scenario was selected to demonstrate the system's capabilities. The proof-of-principle demonstrated clearly the utility of sensor integration and artificial intelligence within this well-known treaty environment. The research concluded that the ITSIP concept would be applicable to a variety of treaties.

This ITSIP research produced a rapidly configurable, portable, real-time, user-friendly, computer driven video display providing treaty inspectors with a computer-based assessment of the probability of a treaty violation.

ITSIP was designed to effectively improve a treaty monitor's capability to make important decisions during the conduct of inspections and improve monitor effectiveness by having treaty-related data readily available for assessment.

14. SUBJECT TERMS

START	Open Skies Treaty
Arms Control	Cooperation Threat Reduction (CTR)
Portal Monitoring	Chemical Weapons Convention (CWC)
Treaty Verification	Nuclear Non-Proliferation Treaty (NPT)

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SUMMARY

The Innovative Treaty Sensor Integration Project (ITSIP) was a DNA-sponsored R&D prototyping effort that demonstrated, to a proof-of-principle stage, *the value of sensor integration and artificial intelligence in an arms control treaty monitoring environment.* In this proof-of-principle effort, TASC (The Analytic Sciences Corporation) developed ITSIP for *use in the continuous monitoring environment of START I and II.* ITSIP also has tabletop demonstration modules for both the International Atomic Energy Agency (IAEA) and the Chemical Weapons Convention (CWC) applications.

In the START application, ITSIP applies sensor integration and artificial intelligence to the problem of collecting, archiving, and analyzing X-ray profile, size, weight and other inspection data to facilitate monitoring and identify compliance ambiguities. The TASC Team developed a comprehensive and detailed methodology called the *Treaty Scenario Analysis Methodology (or TSAM)* to identify potential monitoring approaches under START I and II and quantitatively rank them according to an assessment of the circumventor's cheating incentives, resources, constraints and alternatives.

ITSIP has many features which assist monitors in the inspection process, including: 1) interactive inspection protocol flow chart; 2) intelligent help; 3) suggestions on inspection tactics; 4) automatic sensor analysis and comparison; 5) synergistic integration of monitor and sensor observations; 6) automatic recording of observations and decisions; 7) printout of all inspection activities; and 8) circumvention database.

The TASC Team chose LabVIEW, one of the most powerful data acquisition/instrument control applications currently available, as the principal program to run on the Macintosh System 7.0 Operating System. The Powerbook 180 was chosen as the development and demonstration hardware platform. *The result is a user-friendly and highly portable system* with ample processing power and speed to meet the demands of the monitors or inspectors in various arms control regimes.

A proof-of-principle demonstration of ITSIP was conducted on 1 and 2 February 1994 at DNA's Testbed for Arms Control Technology (TACT) at Kirtland Air Force Base, New Mexico. Employing monitors from the On-Site Inspection Agency (OSIA) with actual experience at the portal monitoring facility at Votkinsk, Russia and simulated Treaty-Limited Items available at TACT, the demonstration showed that *ITSIP enhanced the monitors' understanding of the*

inspection process and gave them greater confidence in their decisions. In some instances, the monitor with ITSIP detected circumventions that might have gone unnoticed without ITSIP.

Additionally, increased momentum towards adoption of the CWC and inspection issues in Iraq raised by the United Nations resulted in the development of two additional notional, "bare-bones," tabletop ITSIP demonstrations for CWC and IAEA applications.

The ITSIP concept is potentially applicable for a broad series of purposes in different treaty and monitoring environments. ITSIP features a modular design and an open architecture system. It is poised for rapid and full development for CWC, IAEA safeguards, and Open Skies applications.

PREFACE

This report has been prepared for the Defense Nuclear Agency (DNA) under the auspices of Contract Number DNA001-91-C-0149, RDT&E RMC Code: B 4613 D TA TA 00069 2600 A AE 25904D. This work was performed by The Analytic Sciences Corporation (TASC). The work was supervised by Lt Col Bernard H. Simelton, USAF, Directorate of Arms Control and Test Limitations/OPAC, DNA.

This report presents the results of the requirements analysis and system architecture, system fabrication, and proof-of-principle demonstration and evaluation of the Innovative Treaty Sensor Integration Project (ITSIP) for the Defense Nuclear Agency. ITSIP's objective was to demonstrate the utility of advanced information technology, sensor integration, and artificial intelligence in an arms control treaty monitoring and verification environment.

The authors wish to acknowledge the assistance of individuals whose support, experience and insights materially aided in the accomplishment of this research effort. Specifically, these individuals are: Lieutenant Colonel Bernard H. Simelton, USAF, (Contract Technical Monitor), Strategic Arms Control Division/TRSO, Ms. Catherine J. Montie, Civ, DNA/OPAC, and Major Robin P. Williams, USAF, DNA/TRSO; Major James M. Wolfe, USA, and Major Michael A. Hallisey, USA, On-Site Inspection Agency (OSIA); and Mr. John McNeilly, DNA Center for Verification Research (CVR), Sciences Applications International Corporation (SAIC).

The ITSIP concept was successfully demonstrated on 1-2 February 1994 at DNA's Testbed for Arms Control Technology (TACT) at Kirtland Air Force Base (AFB), New Mexico. The demonstration showed that ITSIP enhanced an on-site inspection monitor's understanding of the inspection process and gave them greater confidence in their decisions. The ITSIP concept is potentially applicable for a broad series of purposes in different treaty and monitoring environments.

CONVERSION TABLE

MULTIPLY ——————> BY ——————> TO GET
TO GET <—————— BY <—————— DIVIDE

foot	3.048 x E -1	meter (m)
inch	2.540 x E -2	meter (m)
ounce	2.834 952 x E -2	kilogram (kg)
pound	4.535 924 x E -1	kilogram (kg)
tons	4.535 924 x E -1	metric tons

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

FIGURES

SECTION 1

INTRODUCTION

1.1 GENERAL.

This final report describes the technical approach, activities and results of the Innovative Treaty Sensor Integration Project (ITSIP) Defense Nuclear Agency (DNA) contract number: DNA001-91-C-0149. ITSIP was a proof-of-principle prototype computer system development project designed for demonstration testing in a START continuous monitoring environment. ITSIP is a analytical tool designed to assist U.S. personnel in the performance of their monitoring responsibilities under START. ITSIP has powerful processing capabilities especially in the area of sensor interpretation. It is also very user friendly, making it very easy to understand and follow START procedures. The START environment served as a well defined arms control verification test arena in which applications for START and other treaty environments could be assessed. If deemed a worthy approach and if resources permit, further development could be entertained for a full up system for actual use by treaty inspectors, monitors, and planners. It was the team's view that the ITSIP program and system could point the way towards the wider application of sensor integration and artificial intelligence in treaty monitoring applications.

The team postulated a working description of the ITSIP system. This description was: A working prototype system capable of demonstrating (to the proof-of-principle stage) added value to planned START portal monitoring procedures by analyzing the image, weight, length, and inspector provided data of mock START containers and providing a recommendation whether to use one of the 8 available START challenges.

1.2 APPROACH.

The technical approach used to accomplish the work in this project was composed of three tasks. Task 1, Analysis And System Architecture, provided the TASC team with the basic understanding of the problem, and the technical building blocks to assemble the ITSIP system. In Task 2, System Fabrication, the TASC team developed the software and assembled the hardware package for the ITSIP system. Finally in Task 3, the TASC team conducted a demonstration of the prototype ITSIP system. For the test, one baseline Treaty Limited Item (TLI), a simulated SS-25 Booster (i.e., SICBM), was chosen.

In this report, we will discuss the activities and accomplishments in each task of the technical approach followed by some important appendices which provide greater detail and or shed light on ITSIP capabilities.

SECTION 2

TASK 1 - ANALYSIS AND SYSTEM ARCHITECTURE

2.1 SENSOR REVIEW.

One of the first actions in Task 1 was to investigate the sensors that would be available to the TASC team for our proof-of-principle tests which would occur in Task 3. The DNA Program Manager had directed early on in the project that the TASC team must use the Testbed for ARMS Control Technology (TACT) facility at Kirtland AFB, NM (renamed from TOSI). The primary, in fact only, sensor that would be available to the TASC team at TACT was the RAPIDSCAN software system that controls and integrates the Linatron X-ray device data output. Even though there were sensors more suited for a wide-variety of START applications, the X-ray became the sensor of choice for the project. However, the TASC team did review some of the other sensors that could theoretically be used in START. These included a gravity gradiometer, CCTV, and portable scales. Due to resources and test bed limitations the team maintained its focus on the Linatron X-Ray.

From this sensor review the TASC team stipulated a broad program measure of effectiveness (or MOE). The MOE was to show that the ITSIP system can detect undeclared Treaty Limited Items (TLI), or indicate ambiguities in treaty provisions, where an unintegrated mix of sensor data might not. This MOE would guide the development of the ITSIP system in Task 2.

As shown in Figure 2-1, Functional System Description, an initial system functional description was developed. It served as a general guideline for ITSIP development in Task 2. In the final ITSIP prototype system, the team did not include gravity gradiometers or a threat condition function.

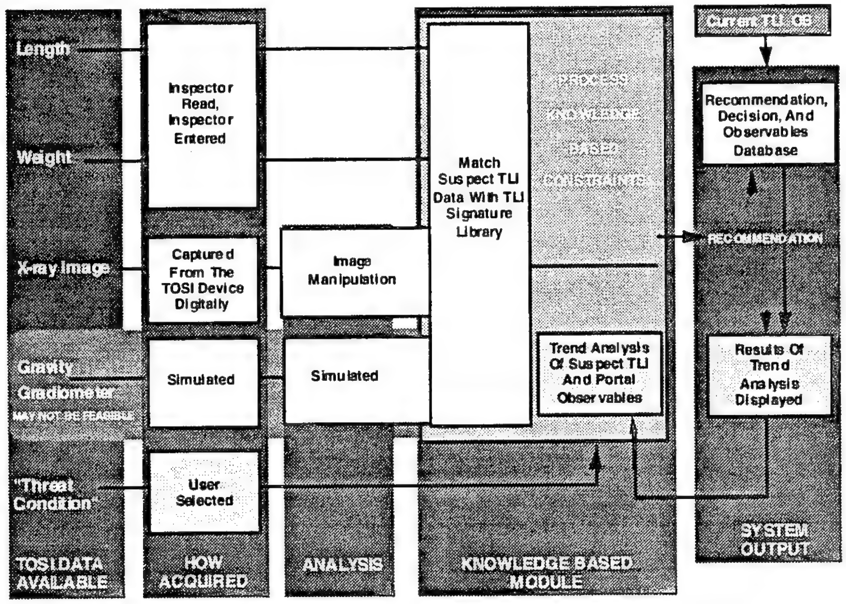

Figure 2-1. Functional system description.

2.2 START TREATY REVIEW AND INSPECTION PROTOCOL ANALYSIS.

After completion of the review of the sensors that could be used with the prototype system, the TASC team carefully reviewed the START treaty and its inspection protocols for applicability. In general, as shown in Figure 2-2, Research Focus, the TASC team focused on the exact language of the START treaty and considered only those sensor integration procedures which could logically be accomplished within the START treaty.

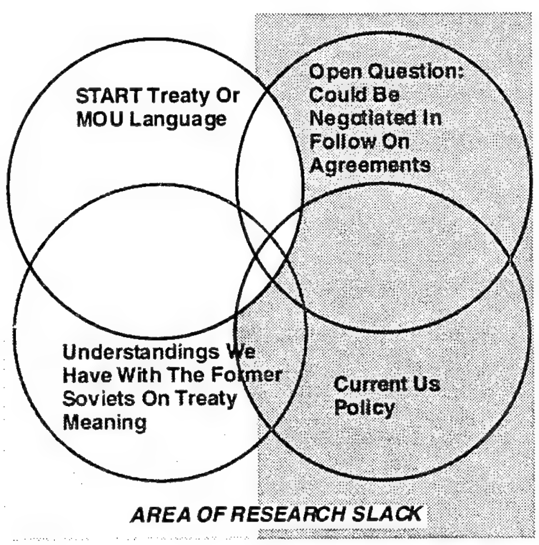

Figure 2-2. Research focus.

In the review of the START treaty, and after a shorter review of other treaty areas of interest, the team narrowed the treaty focus as shown in Figure 2-3, Arms Control Treaty Relationships for ITSIP. The ITSIP system would in this prototyping effort focus only on the START treaty and within that treaty only the continuous monitoring protocol. The program was structured so that it would be clear that the results from the START prototyping effort would be applicable to other treaties however.

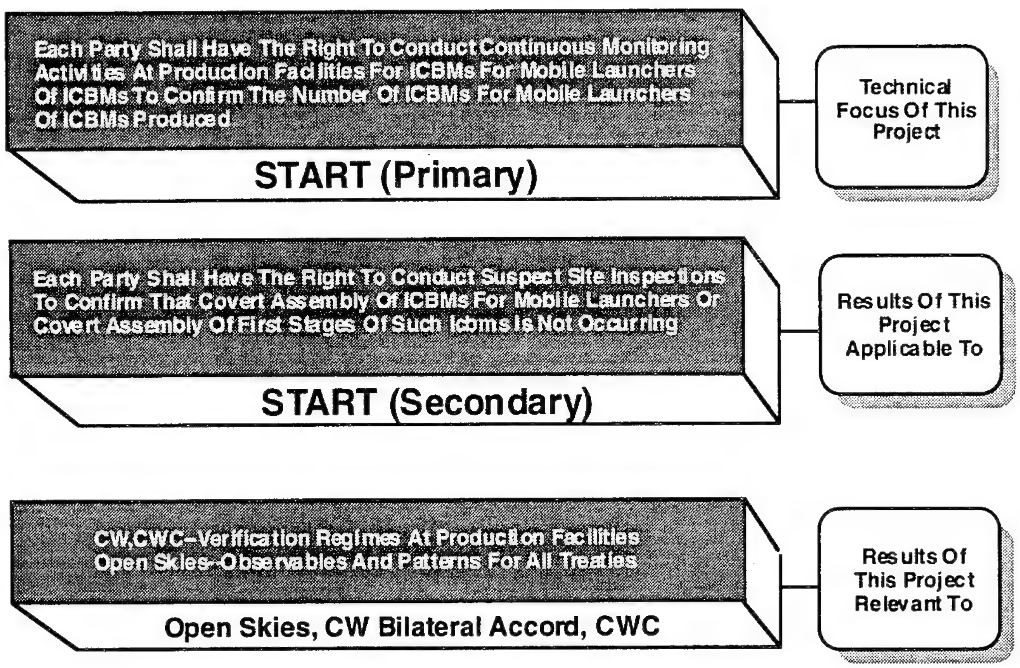

Figure 2-3. Arms control treaty relationships for ITSIP.

As part of the development of the ITSIP START analysis, the TASC Team examined the continuous monitoring protocol in detail and found it quite complex. As a simplifying convention, the TASC Team constructed a series of linked flow chart sheets describing every decision and step mandated by the protocol for both inspected parties and inspectors. These flow charts ensured that every functionality of the ITSIP system could be directly tied back into the treaty. A complete set of flow charts is contained in Annex C to Appendix B.

Within the START continuous monitoring protocol itself, the team further focused on ITSIP relevant performance as shown in Figure 2-4, Relevant ITSIP System Performance Categories. The primary focus was to detect clear violations (or ambiguities) at the continuous monitoring site. These opportunities would take place at specified points in the flow charts of the protocol. Ambiguities could take several forms to include a simple ICBM limit violation to changing the length of a specific TLI. This categorization was critical for ITSIP design since it clearly tied START provisions directly into required ITSIP capabilities.

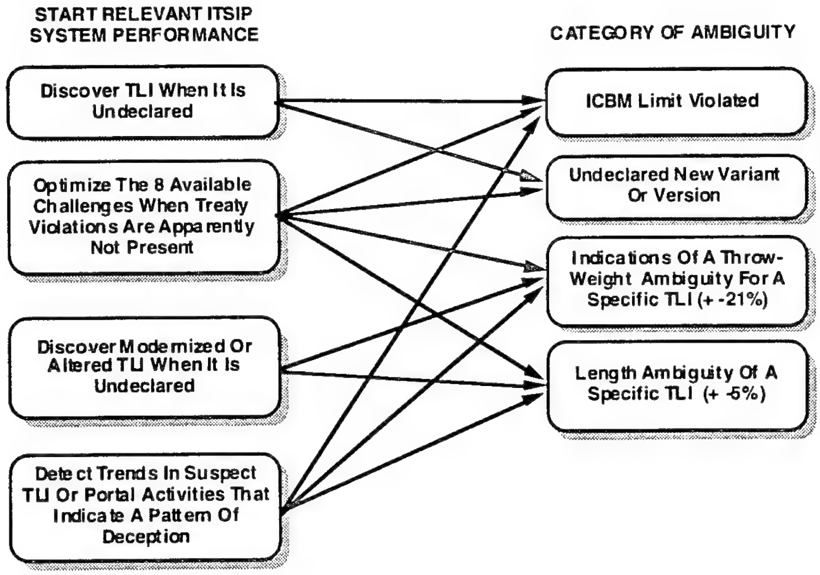

Figure 2-4. Relevant ITSIP system performance categories.

2.3 CIRCUMVENTION SCENARIO DEVELOPMENT.

Once the top level functional design and performance was adequately defined, the team felt it necessary to explore the technical means and the political circumstances that would make actual cheating within the START protocol possible. This was necessary in order to provide for:

- A logical and rigorous basis for selecting the processing objectives of the ITSIP system
- A large amount of organized data that will be integral to the intelligent aspects of the ITSIP system
- A surrogate START portal threat analysis
- A formal basis to evaluate the technical and procedural merits of discrete circumvention and detection techniques

To accomplish this TASC designed and built a tool we called the TASC Treaty Scenario Analysis Methodology (or TSAM for Short). The basic thrust of this tool is shown in Figure 2-5, TSAM Scenario Analysis Methodology.

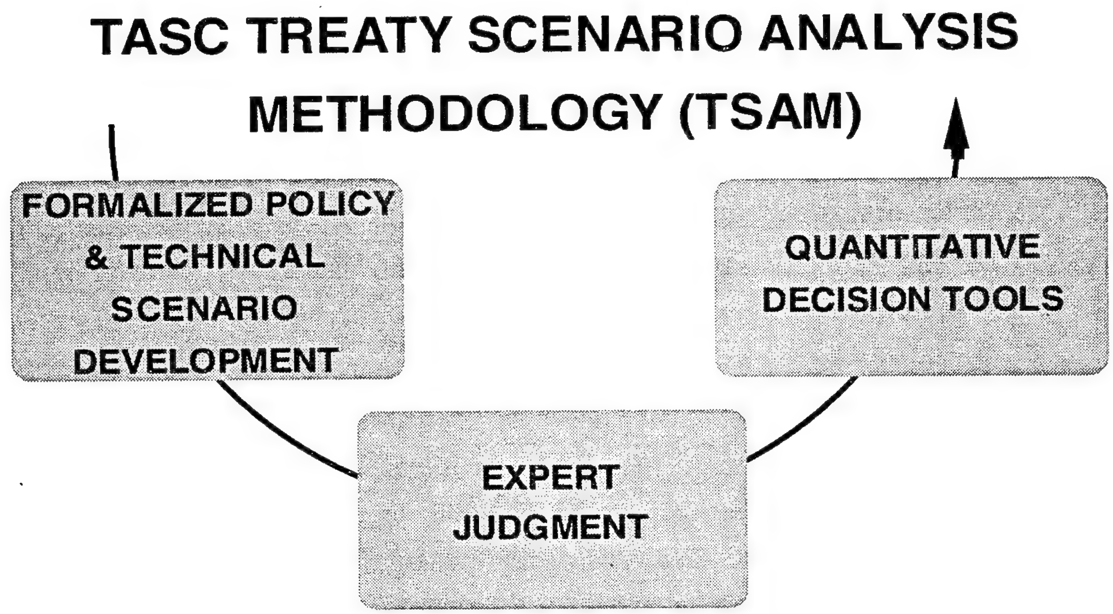

Figure 2-5. TSAM scenario analysis methodology.

The first step was to develop the scenarios (see Figure 2-6, TSAM Scenario Development) that might occur at a portal facility under START, then poll technical experts about the feasibility of the various techniques to be used, and overlay a formal scoring template to allow comparisons of each scenario.

TSAM gave TASC developers a systematic approach for selecting detection techniques (DTs) in a given treaty and inspection protocol environment. In the TSAM analysis for START there were three, equally weighted, quantitative Figures of Merit: 1) Circumvention Score (CS); 2) ITSIP Value (IV); and 3) TOSI Value (TV). CS represents an assessment of the circumventor's cheating incentives and alternatives. CS also takes into account alternative futures in the Former Soviet Union (FSU). IV is the added value, a subjective score, of a deployed ITSIP system in the postulated scenario. The TACT Value is the result of the assessment of the cost magnitude and utility of a TACT-based proof-of-principle test.

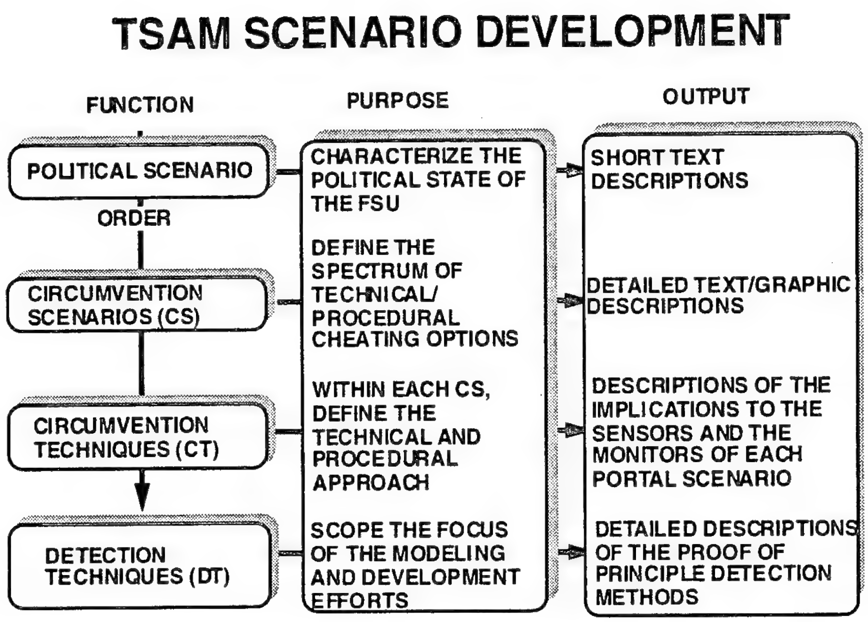

Figure 2-6. TSAM scenario development.

2.3.1 Scoring and Ranking Criteria.

All subjective scores and categories in TSAM have well defined criteria such that there was less than a 10% difference in scoring results between different evaluators. The final ranking was determined by adding CS, IV and TV.

2.3.2 Simplified Scoring Formula.

The simplified formula for the quantitative tool is:

TSAM SCORE = (CS) + (ITSIP VALUE) + (TACT VALUE)

LEGEND: DEFINITION

CS	Value of the circumvention scenario (CS) under consideration, given that political scenario: The probability of cheating and the level of sophistication chosen.
IV	The added value of the ITSIP if deployed at a portal when a particular circumvention technique (CT) is attempted.
TV	Value of testing the detection technique (DT) delineated in a particular CS at the TACT facility.

Each value in the formula was a composite of other scoring indicators such as robustness, technical risk to the circumventor, and affordability.

2.3.3 Presentation of Results.

Once a scenario had been fully developed, assessed and scored it was presented in the format as shown below in Figure 2-7, Results of Treaty Sensor Analysis. Actual circumvention scenarios following the below format are presented in Appendix A.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) VA-006117/AA

CIRCUMVENTION SCENARIO (CS) NO. NICKNAME:	RANK: TOTAL SCORE: CS SCORE: ITSI PVALUE: TOSI VALUE:
CIRCUMVENTION TECHNIQUE DESCRIPTION:	CATEGORY OF START AMBIGUITY: ☐ Production Limit On Mobile ICBMs Exceeded ☐ Undeclared New Variant Or Version ☐ Increase In Throw-weight ☐ Increase In Warhead Loading ☐ Other ________
FEASIBILITY ISSUES:	CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL: ☐ ☐ Medium ☐ Low
INSPECTION PROTOCOL SEQUENCE:	FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS: ☐ Emerging Democracy ☐ Chaos ☐ Oligarchy ☐ Russian Dictatorship
DETECTION TECHNIQUE DESCRIPTION:	DETECTION METHODS TOSI: ☐ X-ray ☐ Weight ☐ Size Measurement ☐ Visual Observation ☐ Other ______ NEW/SIMULATED: ☐ A.I. ☐ NTM ☐ Other ______ ☐ Other ______ ☐ Other ______
	START INSPECTION TYPE:
FEASIBILITY ISSUES:	TESTABLE AT TOSI? ☐ Yes ☐ No
AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ☐ Yes ☐ No ☐ Possibly	TREATY APPLICABILITY: ☐ CWC/CW ☐ Open Skies ☐ NPT ☐ START Follow-on ☐ CFE ☐ Other ______

Figure 2-7. Results of treaty sensor analysis.

SECTION 3

TASK 2 - SYSTEM FABRICATION

3.1 GENERAL.

As Task 1 was drawing to a close, the TASC Team began plans to begin fabrication of the ITSIP system. The RAPIDSCAN system at the testbed facility at TACT used a Macintosh and LabVIEW as its hardware and software, respectively. The TASC Team made a site visit to verify the status of the testbed and the software/hardware configuration. Accordingly it made sense to use both of these as our development environment for the prototype. The ITSIP design configuration is shown in Figure 3-1, ITSIP Hardware/Software Configuration.

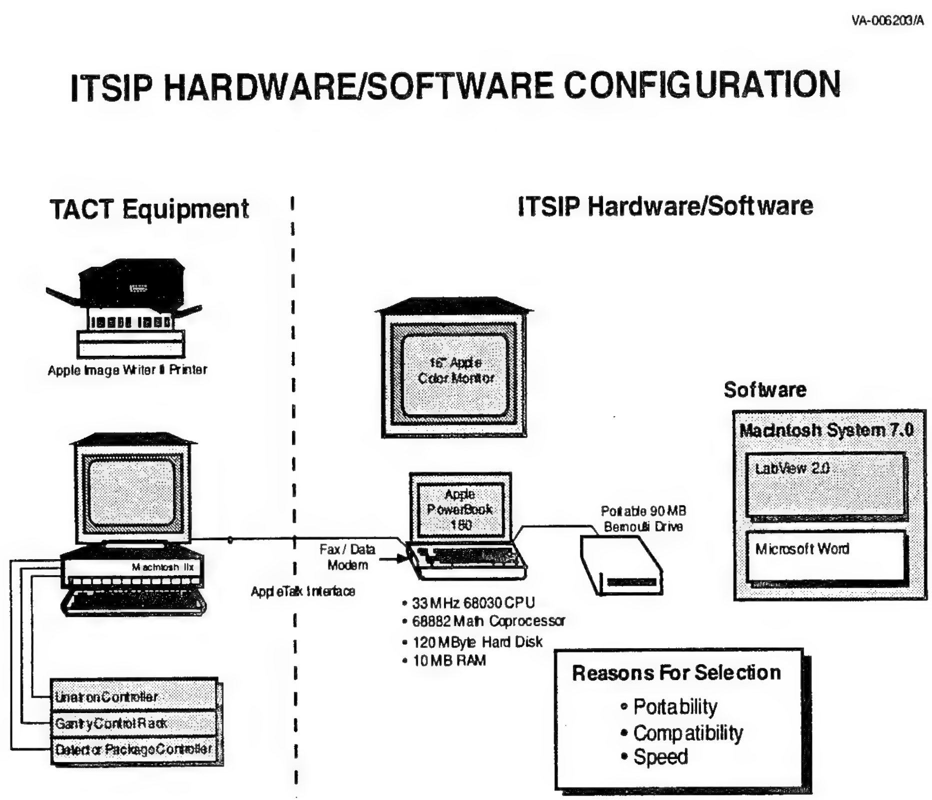

Figure 3-1. ITSIP hardware/software configuration.

3.2 DEVELOPMENT METHODOLOGY.

In writing the software program for ITSIP, TASC used a rapid prototyping approach. This approach emphasized the development of an early operable version of ITSIP that could be demonstrated at the 1993 DNA Conference On Controlling Arms, held in Richmond, VA. The ITSIP operating system based in LabVIEW, utilized many products of Task 1, to include the

Inspection Protocol Flow Diagrams (See Annex C top Appendix B) and the circumvention scenario format.

3.2.1 Selection of LabVIEW Software.

Fabrication of the ITSIP system started with selection of commercial-off-the-shelf (COTS) software tools. LabVIEW is a unique software package developed primarily for instrument control and data acquisition. It is licensed by National Instruments Corporation, 6504 Bridge Point Parkway, Austin, Texas 78730 (Phone: (512) 794-0100). The LabVIEW 2 User Manual, February 1992 Edition, provides detailed information on the capabilities and use of LabVIEW.

The use of LabVIEW in controlling switches, moving mechanical assemblies, and acquiring measured data in the RAPIDSCAN software provided the benefits of flexibility, reconfigurability, and economy. This was a natural application for the program. The importance of these functions in the ITSIP proof-of-principle demonstration at the TACT site suggested the use of LabVIEW as the basis for ITSIP. However, one question remained to be answered: Could LabVIEW support the graphical user interface (GUI) functions which would be key to the success of ITSIP? After some testing it was found to be an acceptable prototype for a GUI environment.

3.2.2 Virtual Instrument (VI) Functions.

A functional program developed in LabVIEW, called a *virtual instrument* or *VI*, presents a visual screen called a *front panel* to the user with components in two basic classes: *controls* and *indicators*. Controls are generally mouse-operated and include buttons, knobs, switches, and numerical fields. They are the means by which the user controls the operation of the program. Indicators include on/off "lights", a wide variety of gauges, and numerical/text fields. Indicators are the means for the program to communicate its results to the user; indicators tell the user what is happening.

3.2.3 Wiring Diagram Design.

A LabVIEW programmer developing a VI selects ready-made controls and indicators from an extensive toolset provided with LabVIEW and places them on the front panel of the VI. Next, the programmer builds functionality into the VI by working within a different facet of the VI called a *wiring diagram*. Controls and indicators placed on the front panel are automatically reflected by icons which appear on the wiring diagram. Programming the VI consists of wiring together the terminals of the controls and indicators with the optional use of logical, numerical,

and text *functions* provided in an extensive function library. As an example, the wiring placed by the programmer might connect the numbers coming from two controls to a multiply function and the result of the multiply function to a needle-and-dial indicator. The product of the two numbers entered in the indicators under user control would then appear in the indicator, visible to the user, when the program was running. The wiring diagram with its icons and wiring, however, would generally not be visible to the user.

3.2.4 Step-by-Step Build and Test Approach.

Fabrication of the ITSIP system started with a "build a little, test a little" approach aimed at an improved understanding of two questions: the question of whether the unique software features of the "G" programming language of LabVIEW could be effectively used in ITSIP; and the question of which ITSIP functions would prove to be useful to a treaty monitor. The point of departure was the flow chart description of the continuous monitoring protocol described in the START treaty. It was preferred to implement a "living" flow chart which would graphically show the progress and current status of the inspection and which would be capable of interacting with a user in the context of particular step, or procedure, of the inspection.

3.2.5 Graphics.

The capability to "import" graphical objects drawn by other Macintosh programs (e.g., MacDraw Pro) provided a versatile means of getting the treaty-specific graphics into the ITSIP program. Next, the *Boolean switch* and *indicator* features of LabVIEW were applied to making the flowchart "live." In rapidly implemented prototypes of small portions of the flow charts, push-buttons were used to "turn on" and "turn off" the symbols. The "on" and "off" status of the symbols, in turn, was shown by LabVIEW indicators consisting of blue- and green-colored versions of the symbols (e.g., a box or diamond.) As limited prototypes were developed, they were reviewed by non-technical users to determine the most effective choices for elements of the human interface, including the selection of push-button operating mode, "on" and "off" colors, and push-button position. In the choice of colors, careful attention was given to luminance of the symbols on the screen, the contrast and aesthetic appeal of printed copies of the color symbols, and visibility of printed color viewgraphs in presentations containing the symbols.

3.2.6 Flowchart Error Detection.

Other choices were made in a similar manner. Automatic detection of out-of-sequence selections was added to assist the user. This included selection of a node before the *predecessor node* was

selected, or selection of more than one *mutually exclusive* choice (e.g., Yes and No) from a decision node. The surrender of flexibility for the sake of error prevention in the flowchart was then avoided by providing a switch to override this error prevention function, and a readout showing the number of exception conditions in effect. Implementation of these features for all nodes in the flowchart required a fairly complicated system of wiring at the programming level, but it was deemed to be worthwhile.

3.2.7 Standard Help Box and Dialog Box Design.

After a working prototype flowchart had been completed, attention shifted to alternatives for providing data input and output from the flowchart. A system of pop-up windows based on the icons in the flowchart was envisioned as a natural approach. Data could be entered based on the measurements and observations, and the system could evaluate the inputs and provide feedback to the user, within the context of each individual *analysis node* represented by a rectangle; likewise, "help" could be given to the user in the context of each different *decision node* represented by a diamond. In view of the large number of nodes, the importance of a standard window design in efficient data presentation to the user was recognized. Hence, the technical developers and the non-technical participants all participated in the development of standard formats for the Help Boxes and the Dialog Boxes. An examples of a dialog box design is shown in Figure 3-2, ITSIP Info and Dialog Box Design. Although the need for additional inputs and outputs was sometimes discovered as development continued, the initial "Help Box" and "Dialog Box" designs proved to be quite stable.

3.2.8 ICM, TLI and CS Processing.

The conduct of the inspection proved to be strongly related to the list of Items of Continuous Monitoring (ICMs). The inspection could be viewed as starting with a full list of all known ICMs that might be in a conveyance. The idea behind the structure of the inspection was to systematically eliminate the possibility that any of these ICMs were present by showing that the conveyance was too small, too low in weight, etc., to contain them. Thus each measurement and observation potentially eliminated one or more ICMs. When the list became empty, the inspection generally was to be concluded.

Another idea arose at this point: to provide pop-up *information* windows for the ICMs themselves, which would be accessed by clicking on the name of the ICM. In the information window an outline drawing of the profile of the ICM could be shown as well as important physical, operational, and programmatic data.

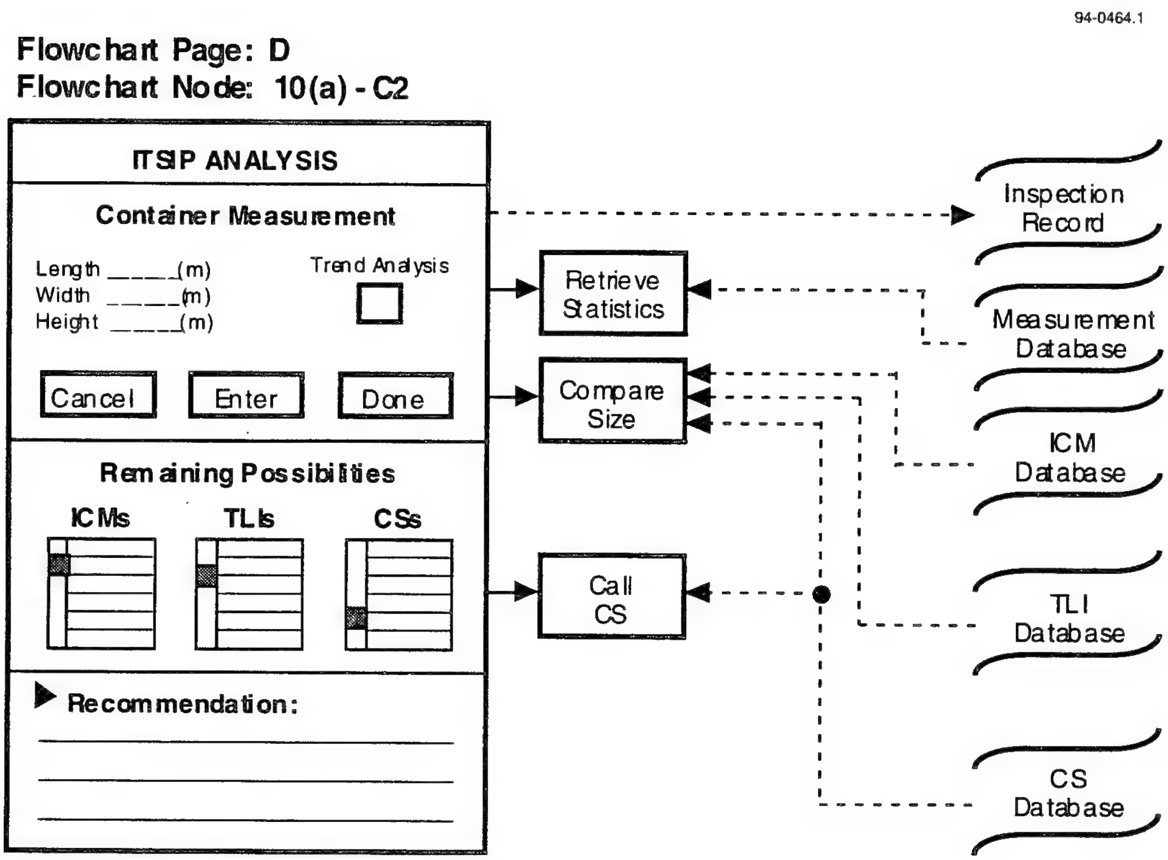

Figure 3-2. ITSIP info and dialog box design.

Scroll boxes provided as part of the LabVIEW toolkit proved to be functionally inadequate for this purpose and it was necessary to develop a specialized scroll box device. This scroll box was used not only for lists of ICMs, but also for lists of Treaty Limited Items (TLIs) and Circumvention Scenarios (CSs).

The next step was to use the measurements entered in a dialog box as a test for the elimination of TLIs and ICMs. For example, if a railcar under inspection was 13 meters (40 feet) long, then TLIs and ICMs greater than 13 meters in length could be excluded. Specialized VIs were written to test all ICMs and TLIs appearing in the scroll boxes against such criteria and to eliminate those meeting the criteria. The theoretical basis for the comparisons was straightforward and involved comparisons of actual ICM and TLI weights and dimensions with entered data. However, "making it come true" in the ITSIP program in near-real-time involved further programming considerations involving the data-driven nature of LabVIEW's G language.

Processing and elimination of CSs were based on not only measurement and observation data but also on the general progress of the inspection, including the selection of particular alternatives.

Development of criteria for CS processing followed a fundamentally different approach using rule bases that are discussed later in paragraph 3.2.10.

3.2.9 X-ray Sensor Processing.

The development of software to support the X-ray analysis to be accomplished in the TACT environment started with consideration of the present RAPIDSCAN mode of operation and the implications of circumvention scenarios developed under ITSIP that involved X-rays. A detailed technical assessment of the software developed for RAPIDSCAN showed that it was very extensive and involved approximately 100 individual subroutines performing functions such as drive motor control, Linatron switching, data acquisition and calibration, and input/output. Little benefit would accrue from simply re-writing these functions; so they were analyzed and "reverse-engineered" to allow their reuse in a new X-ray software suite.

The ITSIP X-ray function was designed to accept and display a file acquired by RAPIDSCAN. Provision was made to compare this data with a series of stored "reference" X-ray profiles corresponding to known ICMs. If a close match was obtained, this would cause ITSIP to warn the operator of a treaty ambiguity. A mean-squared difference (MSD) algorithm was developed in ITSIP to calculate a numerical value for "goodness of fit." Next, thresholds for declaring a "match," based on the MSD value, were developed empirically by observing the operation of the algorithm with actual data. As one of the CSs involved lateral displacement of an ICM, causing its X-ray profile to "shrink" about the centerline, provision was made to compare the actual data with the reference data at a series of different "shrink" and "stretch" factors, or scaling factors. This would accommodate lateral offset of the ICM in the conveyance within an adequate range of movement. At each scale position, the MSD was calculated. By selecting the scale factor corresponding to the lowest MSD and comparing it to the match threshold, ITSIP was capable of determining not only if the scanned X-ray profile matched that of a known ICM, but also its lateral position in the railcar.

In terms of programming, three embedded operation cycles or loops were developed. The "outer" loop sequenced through the set of all designated reference ICM profiles. The middle loop sequenced through the set of all scale factors in the selected range (with range and "fineness" selectable by user at run-time). The inner loop sequenced through each point on a pair of X-ray profiles, calculating differences in the X-ray attenuation and accumulating them for MSD calculation. The data-driven nature of LabVIEW required special, involved accommodations for controlling the sequence of events in order to present a continuous, fluid display to the user, including the pair of curves under comparison at each point. On the other

hand, detailed numerical processing was quickly incorporated in the program by applying its extensive numerical analysis library.

3.2.10 Rule Base Development.

A key element of ITSIP value-added envisioned by its developers was its ability to tell the user when to beware of, or to discount, certain CSs. Development of a systematic technique to allow ITSIP to do this proved to be more involved than elimination of ICMs and TLIs. In some cases, the alternatives in an inspection elected by the In-Country Escort (ICE) should trigger warnings or omission of CSs and in other cases the actions should be triggered by the results of measurements or observations.

The systematic approach was developed by considering each individual CS in the context of the inspection. Any steps or measurements in the inspection that would indicate that the CS was not in use were stated in declaration form as *Elimination Rules*. As soon as an elimination rule was satisfied during the inspection, the rule would *fire*, causing the corresponding CS(s) to be eliminated from consideration. In an analogous manner, inspection steps or measurements that might raise suspicion of the use of a particular CS were stated in declaration form as *Warning Rules*. Firing of a warning rule would cause ITSIP to warn the treaty monitor to beware of use of the corresponding CS(s).

The complete set of warning rules is known as the *CS Warning Rule Base* and is shown in Figure 3-3, CS Warning Rule Base. The annotations regarding the location at which the rule would be programmed in software. The analogous CS Elimination Rule Base is shown in Figure 3-4. In both of these tables, the "Feasible" column is marked with an 'X' if the rule *could* readily be demonstrated within the environment and resources of the ITSIP proof-of-principle demonstration. The column labeled "POP" is marked with an 'X' if the rule *would be invoked* as a result of one of the five demonstrations planned for the ITSIP POP Demonstration. The rules with an 'X' in the POP column were implemented in the ITSIP software, using an ad-hoc approach as warranted by their diversity.

Table 3-1. CS warning rule base.

Rule No.	Feasible	POP	Rule	Node
1	X	X	Large Contained is Observed Within Vehicle	N5.9d or C2.10a
2			Covered or Environmentally Protected Object is Observed Within Vehicle	N5.9d
3			Non-symmetrical Lateral Weight Distribution	------
4	X	X	Path C1..C3..C5 is selected	Flow D
5	X	X	Container X-Ray Scale and Match indicates a match to an ICM with a position offset	C5.10d
6			A Missile is Being Shipped in a Container Other Than a Launch Canister	------
7	X	X	An Access Measurement is Such That all ICMs are Eliminated	N2.9a
8			Path I..N2 is Selected and an Access Measurement is Performed	Flow C and N2.9a
9			ICE Declares That a Non-ICM Missile is Present	-------
10			Path N1..N3..N6 is Selected	Flow C
11			Measured Weight "Narrowly" Allows all ICMs to be Eliminated	N6.9c
12			ICE Declines Request of Monitor to View the Interior of the Railcar	(*)
13	X	X	A Non-ICM Missile Large Enough To Enclose Known ICMs is Observed	L4.11b
14	X	X	Monitor Requests to Perform X-ray Scan are Denied by the ICE	(*)
15			A Large Object (Not Container or Covered Object) Large Enough to Enclose an ICM is Observed	N5.9d or E10.13
16			A Container Large Enough to Contain a Single Stage, But Too Small to Contain an ICM, is Observed	C2.10a or N5.9d
17			A Large Number of Stage-Sized Containers are Being Shipped Through the Portal	--------
18	X	X	The X-ray Signal is not Observed at the Detectors, or Shows Unusually High Attenuation	C5.10d or L3.11c
19			The Vehicle has a High Weight	N6.9c
20	X	X	ICE Declines to Allow Weighing of the Railcar	(*)
21			X-ray Scan Shows a Profile of a SRM With a Diameter not Characteristic of any ICM	C5.10d or L3.11c
22			A Large Number of Garbage Trucks Have Been Observed at the Portal	-------
23			The Garbage Truck has a Higher-Than-Expected Weight	-------
24			X-ray Scan Shows a SRM Characteristic	C5.10d or L3.11c
25			Little or no Absorption of the X-ray Signal is Observed	C5.10d or L3.11c
26			The Second X-ray Scan (but not the First) Shows a SRM Characteristic	C5.10d or L3.11c
27			Weight of the Vehicle and Cargo is Well Below That of an ICM	N6.9c
28			Two X-Ray Scans Taken at Separation Greater Than ICM First Stage Length, Both Show the First Stage Characteristic	C5.10d or L3.11c
29			A Large Number of Containers too Small to Hold ICM First Stages, but Large Enough to Hold Other Stages, are Observed at the Portal	--------

Table 3-1. CS warning rule base (continued).

Rule No	Circumvention Scenario																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	X	X		X							X									X			
2																							
3	X	X																					
4	X	X		X							X									X			
5	X	X																					
6	X	X		X																			
7			X																				
8			X																				
9				X				X									X						
10							X														X		
11							X																
12							X																
13								X															
14								X	X														
15									X														
16										X				X		X							
17									X					X		X							
18											X												
19											X				X		X						
20								X	X		X									X			
21																	X						
22																		X					
23																		X					
24																		X					
25																		X					
26																		X					
27																					X		
28															X								
29															X								

Table 3-2. CS elimination rule base.

Rule No.	Feasible	POP	Rule	Node
1	X		The calculated net weight of the railcar's cargo is substantially less than that of the lightest ICM.	N6.9c
2	X	X	The inspection comes to a conclusion without the measurement of an X-ray scan.	At EOI: not C5.10d or L3.11c
3			The monitor observes a launch canister or container just slightly wider than the diameter of the ICM indicated by the X-ray scan, approximately centered in the railcar.	N5.9d, C2.10a, E2.12b
4	X	X	The X-ray scan indicates low attenuation inconsistent with the presence of an ICM.	C5.10d, L3.11c
5	X	X	No X-ray signal is observed at the detectors.	C5.10d, L3.11c
6	X		The access measured is large enough to admit at least one ICM.	N2.9a
7	X	X	Overall space/access dimensions are not measured.	Chart C: Button N1
8	X		Measured overall vehicle space/ accesses are large enough to admit at least one ICM.	Chart C: Button N8
9	X		Measurements for total vehicle space, rather than for vehicle accesses, are entered.	N2.9a
10	X	X	ITSIP remains functional as the inspection comes to a normal close.	EOI
11	X	X	The inspection comes to a close without weighing of the railcar.	At EOI: not N6.9c
12	X		The gross weight of the railcar with cargo is less than the weight of the lightest ICM alone.	N6.9c
13	X	X	After vehicle weighing, the net weight of the railcar's cargo is equal to, or greater than, the weight of at least one ICM.	N6.9c
14	X	X	The inspection closes without the monitor observing either a launch canister or a large un-enclosed object of any type.	At EOI: not C4.10b, C6.10c, C12.13, E1.12a, L2.11a, L3.11c or L4.11b
15	X	X	The inspection closes without the monitor observing a large un-enclosed object of any type.	At EOI: not C4.10b, C6.10c, C12.13, E1.12a, L2.11a or L4.11b
16	X		All contents of the vehicle under inspection are smaller in any dimension than the corresponding smallest dimension of an ICM first stage.	N5.9d, C2.10a, L2.11a, E2.12b, C12.13
17	X		The net weight of the railcar's cargo is substantially less than the weight of the lightest ICM first stage.	N6.9c
18			The X-ray characteristic of an SRM is observed.	C5.10d, L3.11c
19	X		All contents of the vehicle are smaller in any dimension than the smallest corresponding ICM dimension.	N5.9d, C2.10a, L2.11a, E2.12b, C12.13
20	X		The measured net weight of the railcar cargo is not substantially greater than that of the lightest ICM first stage.	N6.9c
21	X	X	The ICE does not declare the presence of an ICM.	Chart A: Button P3
22	X	X	The inspection comes to a normal conclusion without overt threats of violence.	EOI
23	X		The net weight of the railcar's cargo is not substantially greater than the weight of the lightest ICM.	N6.9c

Table 3-2. CS elimination rule base (continued).

Rule No	Circumvention Scenario																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	X	X						X	X											X			
2	X	X		X							X									X			
3	X	X		X																			
4	X	X		X							X												
5	X	X		X																			
6			X																				
7			X																				
8			X																				
9			X																				
10						X																X	
11							X																
12																							
13							X																
14								X															
15									X														
16										X				X	X						X		
17								X		X				X									
18											X												
19									X														
20															X								
21															X								
22																			X				
23											X												

3.2.11 Other Treaty Application Demonstrations.

During the period of performance of the ITSIP contract, significant changes evolved in the world political situation that had implications for arms control priorities. Among other developments, the START treaty was complicated by the dissolution of the USSR; the Chemical Weapons Convention (CWC) gained increasing momentum towards implementation; and International Atomic Energy Agency (IAEA) inspections of Iraq after Desert Storm uncovered surprisingly extensive nuclear weapons programs. The Defense Nuclear Agency, encouraging the ITSIP developers to show the maximum possible flexibility to changing priorities, stimulated the development of two separate demonstrations of notional ITSIP capabilities under arms control environments other than START.

The first of these demonstrations was the chemical weapons demonstration. A brief but intensive review of documentation on the CWC showed that considerable analytical and scenario work had been completed to help define requirements for CWC, particularly the National Trial Inspections conducted in the U.S. and other countries. The ITSIP development team decided to show how ITSIP could be used in assisting a monitor with the inspection of a declared CWC weapons storage facility based on requirements and scenario definitions provided by the US Army Edgewood Research, Development, and Engineering Center. The overall goal of the inspection would be to verify that the types and quantities of chemical weapons and chemical agents actually present at a storage site were consistent with declaration data as modified by receiving and shipping records.

Inspection flowcharts were developed in drawing form and then imported into ITSIP. The five pages of charts present a view of the overall conduct of the inspection. One of the five pages of flowcharts, titled *Munition NDE* (Non-Destructive Evaluation) was selected for detailed development. On this page, the push-buttons were programmed to operate the flowchart, and dialog boxes were developed. Notional data was displayed in dialog boxes corresponding to *Neutron Activation Testing* and *Acoustic NDE*. Other dialog boxes were designed to facilitate statistical sample size selection by the inspecting party. A fundamental difference in the criteria for conclusion of the CWC inspection compared to a START inspection caused ITSIP system developers to use a different approach than that used for the START treaty. In place of ICMs, *Inspection Objectives* data sheets were placed in a scroll box. As Inspection Objectives data sheets were completed, they would be eliminated from this scroll box, and when the scroll box was emptied, the inspection would be complete. Circumvention Scenarios for CWC were developed as well.

The second non-START application developed was an IAEA inspection comprising inspections of declared uranium enrichment facilities, and undeclared uranium enrichment facilities such as the one discovered at Tarmiya in post-war Iraq. The latter of the two inspections was based on a "forced inspection" environment. The application of ITSIP sought to interpret the remaining evidence of ceased activities for IAEA inspectors. In this demonstration, a multi-page flowchart was shown in drawing form and one analysis node was activated, showing how data could be entered by inspectors based on observations they made. In this case, CSs were replaced by enrichment techniques (ETs), which were individually described on templated forms and illustrated in black-and-white photographs loaded into ITSIP. Examples of ETs include gaseous diffusion, centrifuge enrichment, and electromagnetic isotope separation. In this case, the demonstrated purpose of ITSIP was to serve as an automated technical reference resource for the inspector.

SECTION 4

TASK 3 - ITSIP PROOF-OF-PRINCIPLE DEMONSTRATION AND EVALUATION

4.1 ITSIP PROOF-OF-PRINCIPLE.

A field demonstration of the proof-of-principle ITSIP system was the main activity conducted in Task 3. The purposes of the demonstration were to:

- Demonstrate, in a field environment, the value of sensor integration and artificial intelligence in an arms control treaty monitoring environment;
- Assess ITSIP's value added to START portal monitoring in a setting that, as much as possible, replicates the situation at the portal of a mobile ICBM production facility; and
- Demonstrate the technical accomplishment of ITSIP's design objectives and serve as the basis for an evaluation of the project.

The TACT Facility at Kirtland Air Force Base, Albuquerque, New Mexico was chosen for the demonstration. It provided simulated Items of Continuous Monitoring and excellent inspection and demonstration infrastructure and administrative support. The support provided by TACT personnel was superb.

Planning for the demonstration entailed among other things the authoring of a detailed demonstration plan, a copy of which is included in this report as Appendix B. Planning visits were made to the TACT facility on 20-21 September and 15-17 December 1993. This planning ensured the presence of the necessary support for the demonstration. A major purpose also was to obtain updated X-ray scans of simulated items of continuous monitoring and ensure the ability to transfer X-ray files from RAPIDSCAN to the ITSIP system.

The demonstration was conducted at the TACT Facility during the period 31 January through 2 February 1994. Five separate demonstrations were conducted at TACT during the demonstration period. The sequence of events during the demonstration week was as follows:

DAY	DATE	EVENT
1	31 Jan 94	Final set-up and preparation
2	1 Feb 94	Orientation and safety briefing of participants Demonstration 2 (Concealed Access) Demonstration 5 (Non-Circumvention) Demonstration 4 (Deaden)
3	2 Feb 94	Demonstration 1 (Offset Variant Plus) Demonstration 3 (False Shell) Monitor Debrief

Each of these demonstrations was linked to a specific circumvention scenario developed during Task 1 of the project and described in detail in Annex B to Appendix B, ITSIP Proof-Of-Principle Demonstration Plan. The overall schedule and methodology are depicted in Figure 4-1, ITSIP Demonstration Schedule.

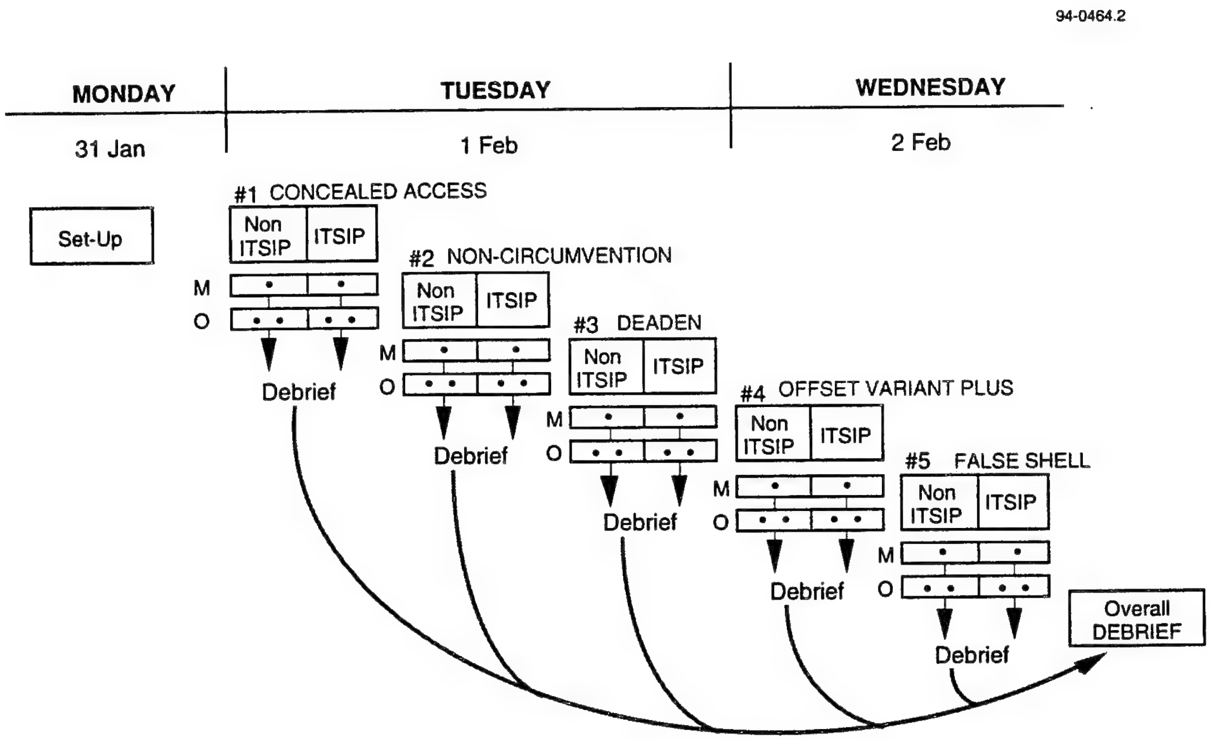

Figure 4-1. ITSIP demonstration schedule.

Every effort was made to structure an impartial, objective, and realistic demonstration of ITSIP's value added. Features of the demonstration that helped to achieve these objectives included the following:

- Inspection procedures that were used were governed strictly by the Inspection Protocol to the START Treaty.
- As noted above, five different demonstrations were conducted, four involving some form of circumvention and one non-circumvention scenario.
- The role of portal monitors for the demonstration was filled by military officers from the On-Site Inspection Agency with actual experience on the ground at Votkinsk, Russia. They were not allowed any advance knowledge of the details of the scenarios or the ITSIP system.
- Each demonstration included a control run conducted without ITSIP and a proof-of-principle run with ITSIP. Different monitors conducted the control run and a proof-of-principle run for each demonstration.

- Official observers were present from DNA and Sandia National Laboratory, and they, along with the monitors, filled out debriefing forms to record their observations and assessments following each demonstration.
- RAPIDSCAN and ITSIP operators, who were aware of the nature of the demonstrations, provided only technical judgments to the monitors that were supported by the outputs from their systems.
- The Demonstration Director acted as umpire and adjudicated issues immediately as they arose.

The need to conduct this demonstration within reasonable cost limits required the use of some notional or simulated equipment, measurements and procedures. For example, the SICBM second stage available at TACT was used to simulate an SS-24, and "notional" dimensions consistent with demonstration equipment and procedures were used in the ITSIP database for ICMs. In other cases, items were marked with or assigned dimensions that were not actual but reflected the dimensions or weights of conveyances in the postulated situation. The use of these notional figures simulated the real situation that could be expected at a portal monitoring location and did not detract from the validity of the demonstration. In addition, label placards were used in certain instances in the demonstrations when it was necessary to denote simulated items. These placards indicated "ground truth" rather than part of an attempted circumvention. Monitors were thoroughly briefed on these measures before the demonstration.

4.2 ITSIP SYSTEM EVALUATION.

As noted earlier, the evaluation of the ITSIP System is derived principally from results of the demonstration. Comments on the value added of ITSIP were compiled from detailed comments provided after each demonstration and at the end of the overall demonstration by monitors and observers. The results of each of the demonstrations are summarized below, followed by an overall summary. (See Annex B in Appendix B, ITSIP Proof-Of-Principle Demonstration Plan for a summary of each circumvention scenario evaluated.)

4.2.1 Demonstration #1: Concealed Access.

In this demonstration, the monitor without ITSIP walked around the railcar but did not discover evidence of circumvention. The monitor with ITSIP was alerted to the possibility of a "concealed access" scenario and made a thorough search of the exterior of the railcar that revealed evidence of possible circumvention. This gave him the basis for arguing for further inspection, which ultimately revealed an undeclared Item of Continuous Monitoring (ICM). Comments from this demonstration included the following:

- "ITSIP pointed out that in my inspection of four sides of the railcar, I neglected the top and bottom." (Monitor #2)

- "The inspection never progressed to an X-ray scan without ITSIP...ITSIP was very helpful." (Observer #2)

- "It was a good training tool." (Observer #1)

- "...the inspection process [on ITSIP] could perhaps be streamlined." (Observer #1)

4.2.2 Demonstration #2: Non-Circumvention.

In this scenario, both monitors confirmed non-circumvention. The ITSIP run took longer than the non-ITSIP run, because the monitor, now sensitized to the possibilities for circumvention, felt obliged to check out all possibilities. Comments from this demonstration included the following:

- "[ITSIP] was helpful, but a bit confusing at first. Wanting to ensure that circumvention was not occurring, I felt compelled to review unnecessary options, which took more time than was necessary, whereas, without ITSIP, the inspection would have been completed more quickly." (Monitor #1)

- "ITSIP did a great job and led them to where they needed to go. However, the monitors found it hard to believe." (Observer #2)

- "Having the comparison plots for RAPIDSCAN [on ITSIP] was helpful. It gives a check on the operator's judgment and assists with documentation..." (Observer #1)

4.2.3 Demonstration #3: Deaden.

In this scenario, the monitor without ITSIP became suspicious from the "poor RAPIDSCAN results," but was not sufficiently confident to detain the railcar. The monitor with ITSIP was cued to the possibility of a deaden scenario and took a second X-ray at a different point on the railcar at the suggestion of ITSIP. This X-ray provided strong evidence of the presence of an ICM, and the monitor declared an ambiguity and detained the railcar. Comments from this demonstration included:

- "[I] used ITSIP in a confirmation role. [I] relied more on the RAPIDSCAN profile, operator assessment, and diameter measurement...[ITSIP provided] additional evidence to bring to the attention of the in-country escort." (Monitor #2)

- "CS [Circumvention Scenario] and changes in RAPIDSCAN measurement on the second scan were very helpful...it was good to have a check on the operator." (Observer #1)

- "ITSIP identified the spoofing and gave an additional measure (second test) to use in overcoming the spoofing. The monitor without ITSIP did not discover the problem." (Observer #2)

4.2.4 Demonstration #4: Offset Variant Plus.

In this scenario, the monitor without ITSIP requested an X-ray scan. It revealed an object with dimensions that did not match an ICM. While he was aware of the possibility of an offset, he still released the railcar. The monitor with ITSIP also requested an X-ray scan. ITSIP matched the results to the profile of an SS-24 laterally offset in the railcar. The monitor declared an ambiguity and detained the railcar. Comments from this demonstration included the following:

- "ITSIP tracked down the cheating scenario and identified how the missile was offset. The [ITSIP] diagram of the spoofing scenario was very helpful to understand what was going on." (Observer #2)

- "It helped to confirm findings of RAPIDSCAN and provided additional treaty cheating scenario details to confirm suspicion of cheating and determine required course of action." (Monitor #1)

- "The value added by ITSIP here was an even-handed and logical presentation of data. Theoretically, the baseline monitor (to whom ITSIP was not available) should have rejected the item...thus, I conclude that in this case ITSIP's value added was minimal." (Observer #3)

4.2.5 Demonstration #5: False Shell.

In this demonstration, both monitors discovered the attempted circumvention. The monitor without ITSIP suspected the possibility of a smaller missile contained with the "SS-18X" and requested an X-ray, which revealed the profile on an SS-24. The monitor with ITSIP was alerted to the possibility of a "false shell" scenario by ITSIP, which recommended an X-ray. Both RAPIDSCAN and ITSIP confirmed the match of the results to the profile of an SS-24. Comments from this demonstration included the following:

- "ITSIP was valuable in that it provided possible CSs (Circumvention Scenarios) that I may not have thought about." (Monitor #2)

- "The presence of the treaty text and the comfort of having the steps laid out were very reassuring in this 'odd' situation." (Monitor #2)

- "ITSIP provides a very useful structure to help lead the monitors through the inspection, while also integrating and analyzing information from the sensors. It greatly enhances the monitor's effectiveness..." (Observer #2)

- "ITSIP took almost 40 minutes (vs. 25 minutes for the inspection without ITSIP) with the same result. The value added here was minimal..." (Observer #3)

4.2.6 Overall evaluation.

4.2.6.1 General. ITSIP clearly demonstrated the general value of a sensor integration and artificial intelligence approach to arms control monitoring and the specific value it would have in a portal monitoring environment, providing that all parties to the inspection agree to the use of such a system. It successfully displayed and tracked inspection procedures and results in a way that was helpful to monitors and increased their confidence in their findings. It frequently provided additional information and suggestions that monitors found to be helpful. ITSIP successfully interpreted the results of X-ray sensor data from RAPIDSCAN collected during demonstrations and integrated this with other inspection observations to provide greater confidence in the inspection findings. At the end of each demonstration, ITSIP provided a written report on inspection procedures that were followed and on results that was provided to the monitors for their records. Comments from demonstration participants supported these conclusions and highlighted the value added of ITSIP in the following areas:

- Helped monitors think of circumvention scenarios that might otherwise have been overlooked.
- Helped monitors think of and use alternate inspection strategies.
- Improved monitor effectiveness with presentation of treaty-related data, such as ICM dimensions and on-line treaty documentation.
- Helped monitors by presenting a structured, graphical view of the inspection process and illuminating START Inspection Protocol provisions that OSIA monitors may not have been aware of.
- Automatically collected inspection data and generated reports.
- Automatically matched X-ray curve to baseline curves in database and evaluated the fit.
- Integrated and analyzed sensor information.

4.2.6.2 Impartiality of the Demonstration. Observers were surveyed as to whether or not they felt the demonstration was impartial. All observers felt that the demonstrations were fair and impartial in every case.

4.2.6.3 Discovery of Circumvention or Non-circumvention. As Figure 4-2, Discovery of Circumvention/Non-Circumvention, notes, circumvention was sometimes missed without ITSIP but never with ITSIP. Observers were less sanguine about the accuracy of the results of the inspections without ITSIP than were the monitors who conducted them. In general, comments

by both monitors and observers suggested that ITSIP increased the monitors' confidence in inspection procedures and results.

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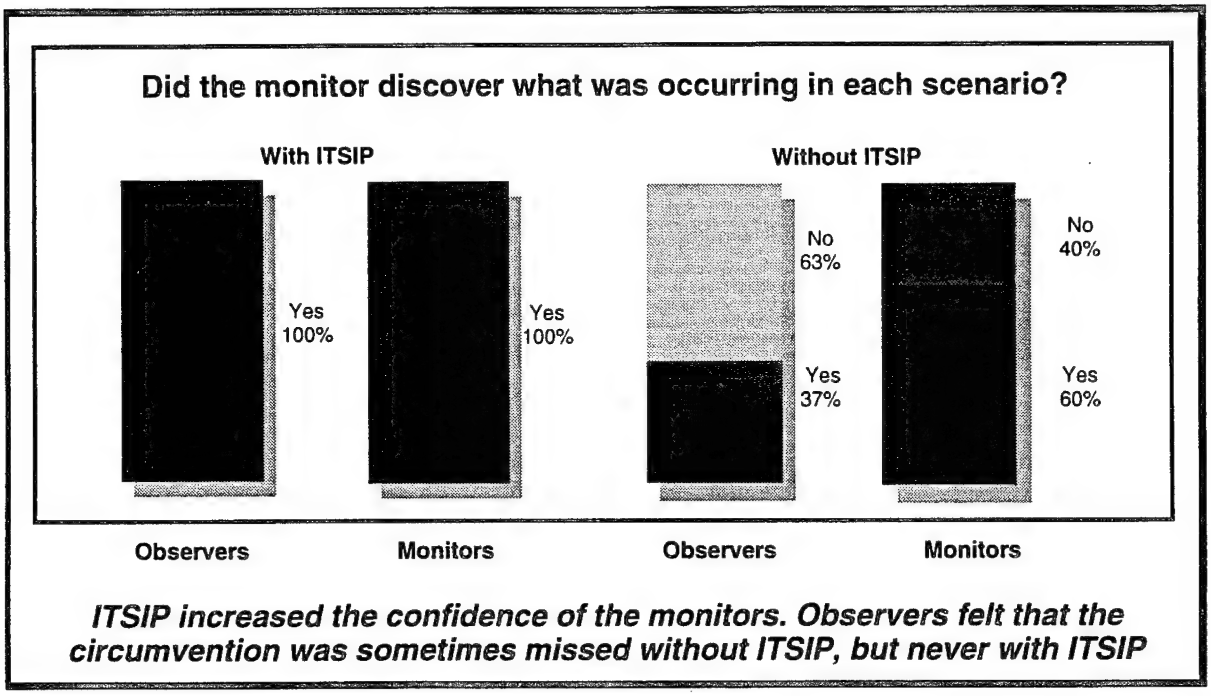

Figure 4-2. Discovery of circumvention/non-circumvention.

4.2.6.4 Usefulness of ITSIP. As the Figure 4-3, Usefulness of ITSIP, shows, ITSIP was always judged to be helpful in the conduct of inspections. In the monitors' eyes, it contributed in an important or very important way to their forming conclusions. As with the discovery of circumvention, monitors rated it somewhat less highly than did the observers, perhaps reflecting a desire not to seem to be reliant on an outside system.

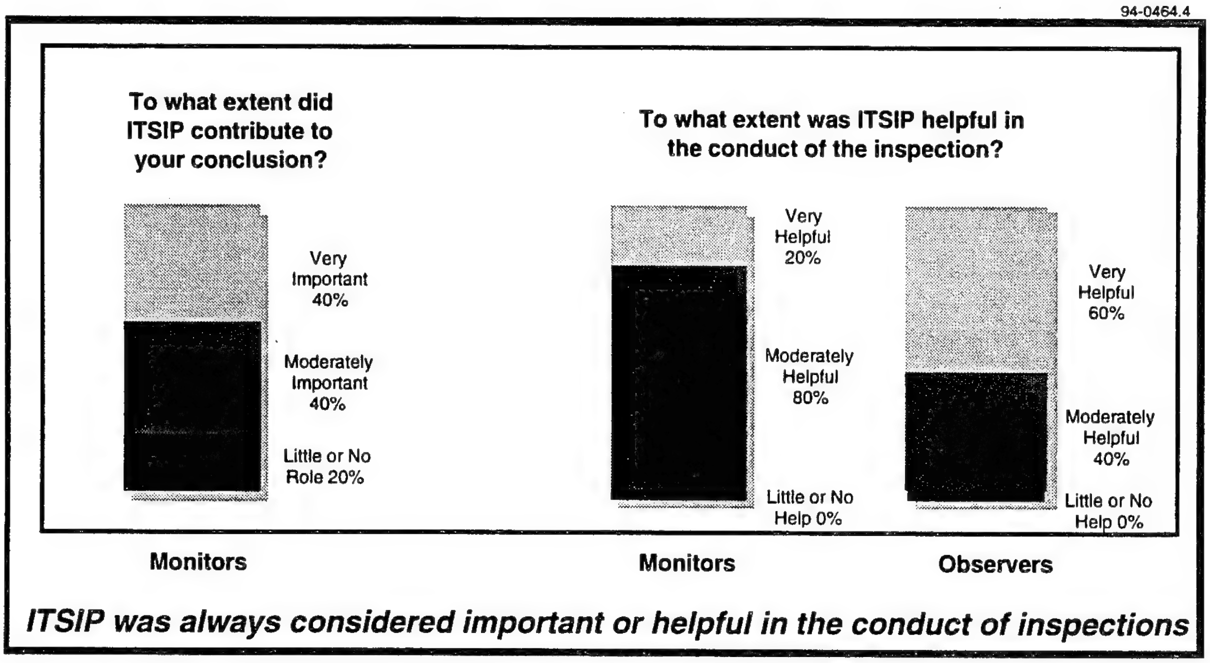

Figure 4-3. Usefulness of ITSIP.

4.2.6.5 User-friendliness of ITSIP. Even though ITSIP was developed as a proof-of-principle prototype, not an operational system, monitors rated it as satisfactorily or very user-friendly. (See Figure 4-4, User-Friendliness of the ITSIP System.)

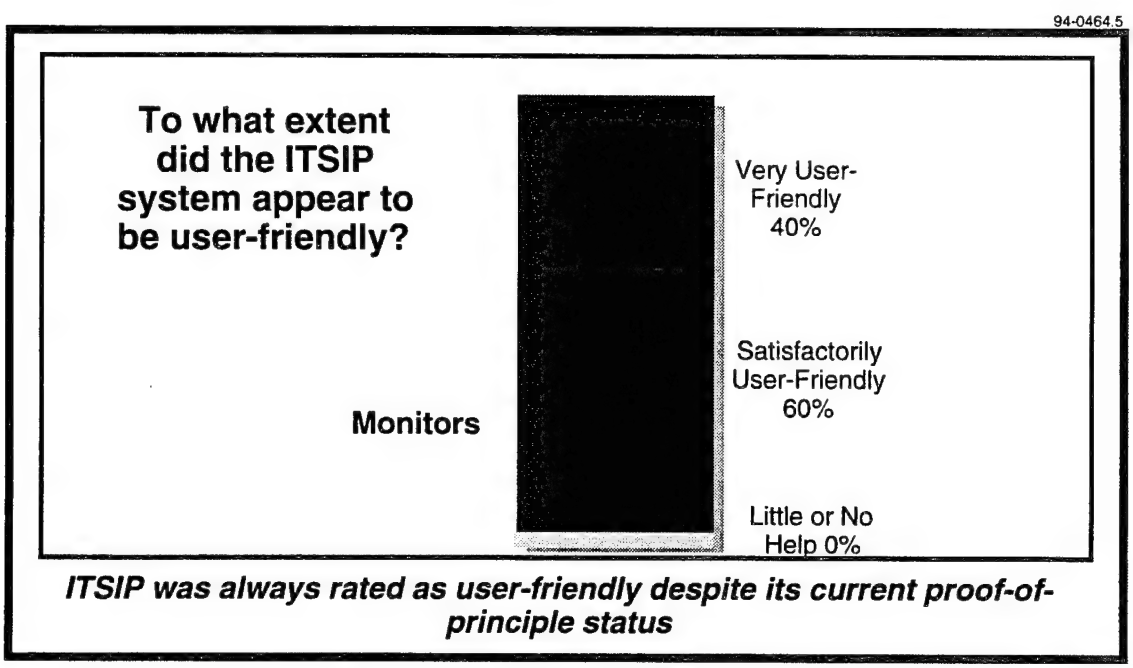

Figure 4-4. User-friendliness of the ITSIP System.

However, demonstration participants made a number of suggestions for improving the ITSIP system, should some application of it be further developed for fielding. These included:

- Improved flow chart display, including automatic scrolling, improved topology, and clarified wording.
- Enhanced execution speed.
- Clarified wording of some procedures or recommendations.
- Some dialog boxes compressed to fit on a single screen to eliminate scrolling.
- Clarified circumvention warning messages and X-ray processing results.
- Confidence levels displayed for ICMs, CSs, and X-ray processing results.
- Text editor with greater functionality for the inspection report.
- A mode of operation which masks circumvention scenarios from host country viewing.

SECTION 5

RECOMMENDATIONS FOR FURTHER DEVELOPMENT

5.1 OTHER APPLICATIONS FOR ITSIP.

The ITSIP concept of sensor integration and artificial intelligence has clear relevance in a number of arms control monitoring applications. These applications were suggested during task demonstrations, at conferences and during other tabletop ITSIP demonstrations. These include:

5.2 OTHER START INSPECTION REGIMES.

ITSIP can be expanded into other START inspection regimes.

5.3 CHEMICAL WEAPONS CONVENTION (CWC).

Multiple uses within the Chemical Weapons Convention (CWC.) An illustrative application of ITSIP was developed that showed how it could be a potent tool for inspectors to help manage complex procedures and large quantities of data, and assess and integrate the results of various types of non-destructive analyses. From a less adversarial perspective, an ITSIP-type system could be developed to assist chemical firms in understanding their treaty obligations and in planning, preparing for, and conducting routine and challenge inspections of their facilities, a problem to which many chemical companies have so far given inadequate attention.

5.4 NON-PROLIFERATION TREATY (NPT).

Under the Non-Proliferation Treaty (NPT), International Atomic Energy Agency (IAEA) inspectors face challenges similar to those that will be faced by CWC inspectors in managing complex procedures and large quantities of data and assessing and integrating the results of non-destructive assay. The revelation of the extent and progress of the Iraqi nuclear program has highlighted the problem of detecting undeclared nuclear programs and activities. Illustrative applications of ITSIP were developed for these difficult problems that showed how an ITSIP-type system could assist inspectors in identifying indicators of prohibited clandestine activity as well as assist in the monitoring of permitted nuclear activities.

5.5 COOPERATIVE THREAT REDUCTION (CTR).

A concern of the Cooperative Threat Reduction (CTR) Program is to keep track of and assist in the dismantling of nuclear warheads and other nuclear materials from the arsenals of the states of

the Former Soviet Union. As with the CWC, the quantities of data involved are large, and sensors can make an important contribution.

5.6 OPEN SKIES TREATY.

Under a follow-on to the Treaty on Open Skies or a regional application of that concept, the ability to perform real-time processing of digital sensor data and sensor control that the ITSIP approach offers would be very important to getting the most information from each flight.

5.7 IRAQI ACTIVITIES.

Highly intrusive safeguards are being implemented to monitor Iraqi production of missiles and other key items of military equipment. A ITSIP-type system that can integrate sensor data with the added capability of being able to process visual imagery data from video cameras in near-real time, cueing international inspectors to the possibility of prohibited activity, would be of obvious benefit.

5.8 SUMMARY.

At the end of the proof-of-principle demonstration, participants were asked for their comments on applications of the ITSIP concept beyond the START portal monitoring environment. A general comment they made was that, the more extensive or complicated the sensor data or diverse the sensor set, the greater is the need for an ITSIP-type system. They generally agreed that the extensive data requirements of the Chemical Weapons Convention would highlight the usefulness of a system like ITSIP. Other applications in Cooperative Threat Reduction and the Intermediate Nuclear Forces Treaty were mentioned. It was suggested that ITSIP could be used to conduct inspections in a hostile environment such as Iraq, where its acceptability by the inspected party is a less important factor. The monitors, who came from the operational environment of OSIA, strongly supported the value of ITSIP as a training tool, and also said that portions of it could be usefully extracted as a handbook.

SECTION 6

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APPENDIX A

ITSIP SYSTEM CIRCUMVENTION SCENARIOS

APPENDIX A

ITSIP SYSTEM CIRCUMVENTION SCENARIOS

A.1 GENERAL.

This Appendix presents the 23 different Circumvention Scenarios (CS) developed to support the Treaty Scenario Analysis Methodology (TSAM). Possible circumvention techniques and the feasibility of occurrence are described for each CS To assist the ITSIP operator, detection techniques and "feasibility Issues" are presented for consideration.

As appropriate, the CSs have been scored and ranked as to likelihood of use. For clarity illustrations have been included to support appropriate CSs.

The 23 CSs developed under the ITSIP program are:

NUMBER	CIRCUMVENTION SCENARIO (CS) NAME
1	Deaden
2	Garbage Truck
3	Concealed Access
4	Rhineland
5	To Err is Human
6	Heavyweight
7	Degausser
8	Offset Variant
8a	Offset Variant Plus
9	Piecemeal
10	Piecemeal Plus
11	False Shell
12	Tunnel
13	Empty Stage
14	Breakout Stockpile
15	Telsa Coil
16	Up-Stage
17	X-Ray Dupe
18	Split Stage
19	Bait and Switch
20	Shell Tool
21	False Edges
22	Two for One

A.2 SAMPLE CIRCUMVENTION SCENARIO CHART.

Once a scenario had been fully developed, assessed and scored it was presented in the format as shown below in Figure A-1, Sample Circumvention Scenario (CS). Actual circumvention scenarios are depicted in Figures A-2 through A-24.

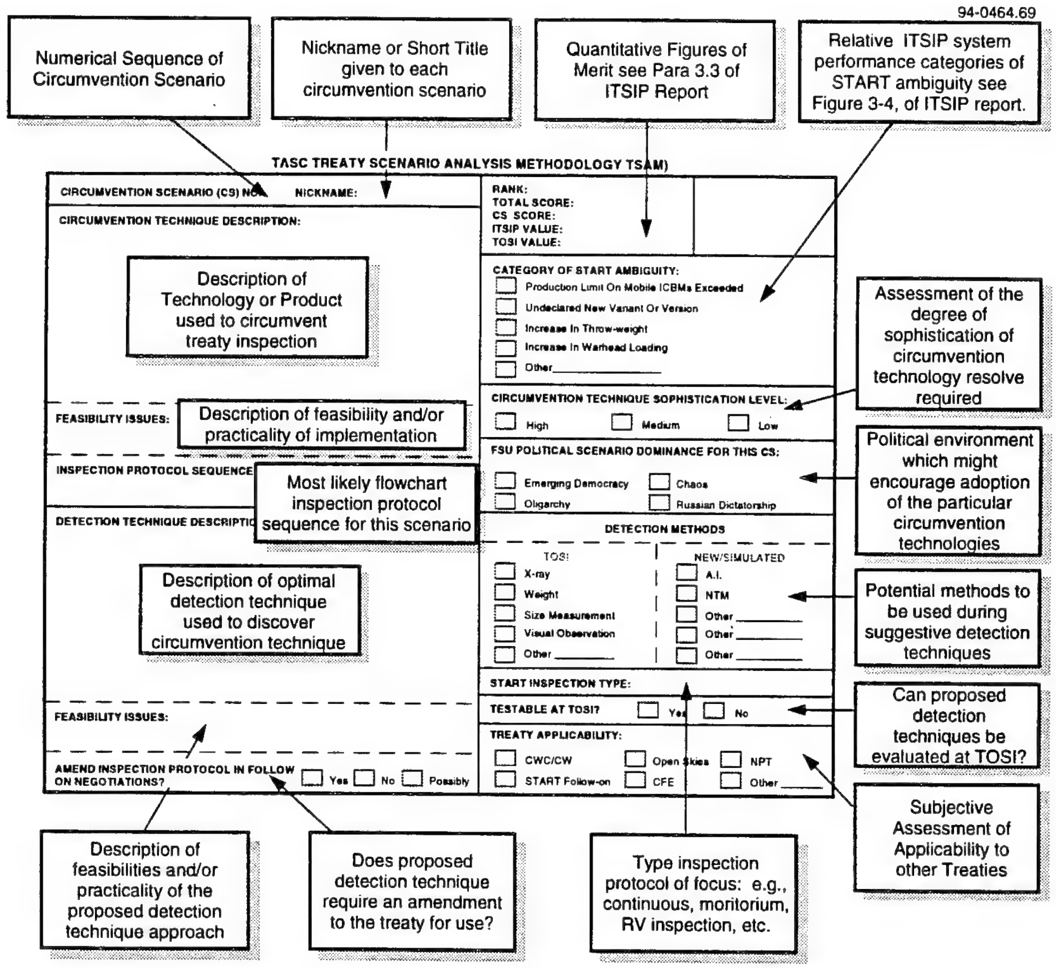


Figure A-1. Sample circumvention scenario (CS) chart.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.7

CIRCUMVENTION SCENARIO (CS) NO. 1 **NICKNAME:** Deaden

RANK: 11
TOTAL SCORE: 5.96
CS SCORE: 2.51
ITSIP VALUE: 1.00
TOSI VALUE: 2.45

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The inspected party is shipping SS-24 missiles of the rail-mobile type from the missile assembly facility in violation of treaty ceilings.

Thick lead plates have been inserted on either side of the missile canister to absorb the X-ray signal.

FSU ICE claims that U.S. system is defective, and presses on with the movement of SS-24s despite U.S. on-site objections.

FEASIBILITY ISSUES:
Full length lead plates may be too heavy to be practical. This technique could quickly arouse the suspicion of the monitors.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other ______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
□ High □ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- □ Emerging Democracy
- ■ Chaos
- ◩ Oligarchy
- ◩ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Although the data obtained by the X-ray sensors is inconclusive, the low signal level, combined with a normal signal level at the reference detector, is cause for suspicion. As a response, ITSIP may recommend running an X-ray scan at a higher energy setting on the Linatron. (If weighing or measurement of the seismic signature is permitted, high weight or unusual vibration provides confirming evidence of a possible violation.) ITSIP warns the inspector of excessive X-ray attenuation and indicates high probability of an ambiguity.

FEASIBILITY ISSUES:
Configuration of the X-ray system may not permit the energy level to be changed readily.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
■ Weight	□ NTM
□ Size Measurement	■ Other Seismic Sensor
□ Visual Observation	□ Other ______
□ Other ______	□ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ■ Yes □ No

TREATY APPLICABILITY:
- □ CWC/CW
- □ Open Skies
- ■ NPT
- ■ START Follow-on
- □ CFE
- □ Other ______

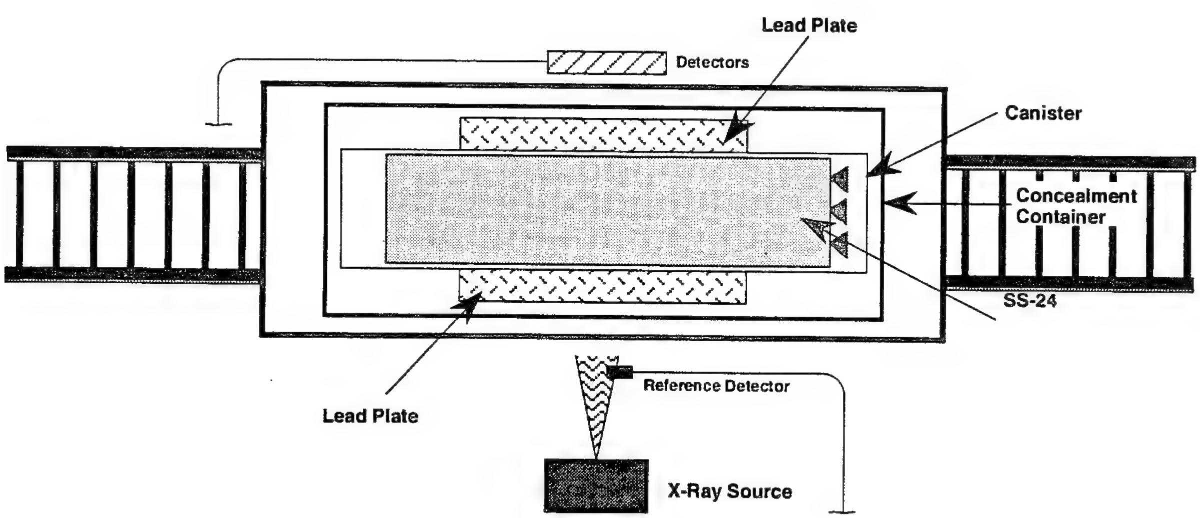


Figure A-2. Circumvention scenario no. 1: deaden.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0454.9

CIRCUMVENTION SCENARIO (CS) NO. 2 **NICKNAME:** Garbage Truck

RANK:	18
TOTAL SCORE:	4.23
CS SCORE:	1.24
ITSIP VALUE:	3.00
TOSI VALUE:	0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

SS-24 rail mobile ICBMs are being produced in excess of treaty ceilings. In order to avoid detection, the missiles are shipped in stages, with nozzles and other hardware attached, and enclosed in a protective container, in garbage trucks, concealed by a covering of "garbage." The break-beam sensors indicate that the truck is large enough to contain an SS-24 first stage. The ICE, with an amused demeanor, asks whether the inspectors will require a search.

FEASIBILITY ISSUES:
Requires the construction or re-tooling of a covert missile assembly facility.

INSPECTION PROTOCOL SEQUENCE:
R1→R3→END

DETECTION TECHNIQUE DESCRIPTION:

ITSIP has been keeping track of the number of garbage trucks exiting the facility and has detected an increase in the last several months.
(If weighing is allowed, the weight sensor indicates that the truck is heavy enough to contain a first stage. If a vibration sensor is used, ITSIP detects a spectrum of vibration that is different from the typical "garbage" spectrum. ITSIP recommends a challenge inspection. The inspection procedure followed is II→CN1→CN3→CN5→CN16→CN18→CN21→FF→CE1→CE5→CE9→DD→CC1→CC3→CC5→END. ITSIP interprets the X-ray scan and indicates a high probability that the container holds an SS-24 SRM.

FEASIBILITY ISSUES:
If weight or vibration measurement is not allowed, the five challenge inspections will be quickly exhausted.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ☐ Yes ☐ No ■ Possibly

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- ☐ Increase In Throw-weight
- ☐ Increase In Warhead Loading
- ☐ Other ______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
☐ High ☐ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
☐ Emerging Democracy ■ Chaos
◩ Oligarchy ◩ Russian Dictatorship

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	■ A.I.
■ Weight	☐ NTM
■ Size Measurement	■ Other Vibration Sensor
■ Visual Observation	☐ Other ______
☐ Other ______	☐ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ☐ Yes ■ No

TREATY APPLICABILITY:
☐ CWC/CW ☐ Open Skies ■ NPT
■ START Follow-on ☐ CFE ☐ Other ______

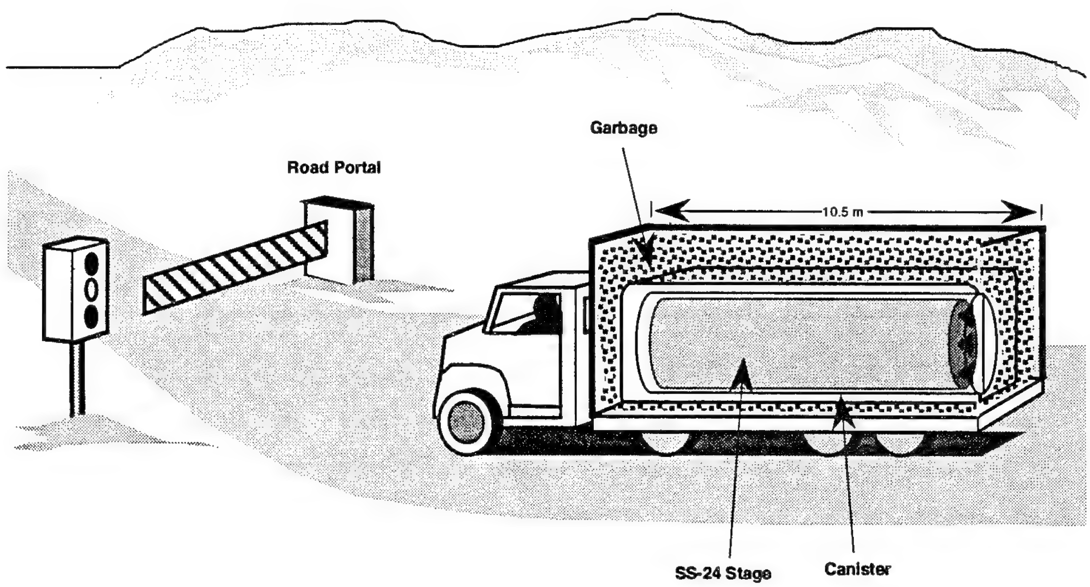


Figure A-3. Circumvention scenario no. 2: garbage truck.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.11

CIRCUMVENTION SCENARIO (CS) NO. 3 **NICKNAME:** Concealed Access

RANK: 3
TOTAL SCORE: 9.25
CS SCORE: 3.25
ITSIP VALUE: 4.00
TOSI VALUE: 2.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

An SS-25 road mobile ICBM in excess of the numerical limit on non-deployed mobile ICBMs has been produced. The SS-25 has been lowered into a rail-car with a specially designed removable top which is then reattached is such a way as to hide its purpose. The only other apparent "doors" allowing access into the rail-car have a width of 1.5m, which is smaller than the 1.8m size criteria in Para 3 of Annex 12 to the Protocol. Therefore, at the portal, the ICE allows only measurement of the "accesses" into the vehicle. (This technique could also be used to ship SS-24s; however, at the SS-24 plant, challenge inspections for first stages may be invoked by the monitor.)

Without a change in the protocol, this is virtually a foolproof technique.

FEASIBILITY ISSUES:

No significant issues.

INSPECTION PROTOCOL SEQUENCE:

P1→P3→I→N2→N7→END

DETECTION TECHNIQUE DESCRIPTION:

The inspection procedure of measuring the access activates a warning flag on the ITSIP: What if a larger concealed access is present? ITSIP recommends to the monitor to declare the roof as a "door" and proceed with the inspection by viewing the interior of the vehicle. If permission is denied, ITSIP will recommend obtaining permission to perform an X-ray scan and then permission to weigh the vehicle. If all these procedures are denied, ITSIP will indicate a high probability of treaty ambiguity, particularly if this is inconsistent with past ICE behavior.

FEASIBILITY ISSUES:

No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

CATEGORY OF START AMBIGUITY:

■ Production Limit On Mobile ICBMs Exceeded
■ Undeclared New Variant Or Version
■ Increase In Throw-weight
■ Increase In Warhead Loading
□ Other________________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

□ High □ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

□ Emerging Democracy ■ Chaos
◩ Oligarchy ◩ Russian Dictatorship

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	■ A.I.
■ Weight	□ NTM
■ Size Measurement	□ Other ________
■ Visual Observation	□ Other ________
□ Other ________	□ Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? □ Yes ■ No

TREATY APPLICABILITY:

□ CWC/CW □ Open Skies ■ NPT
■ START Follow-on □ CFE □ Other ________

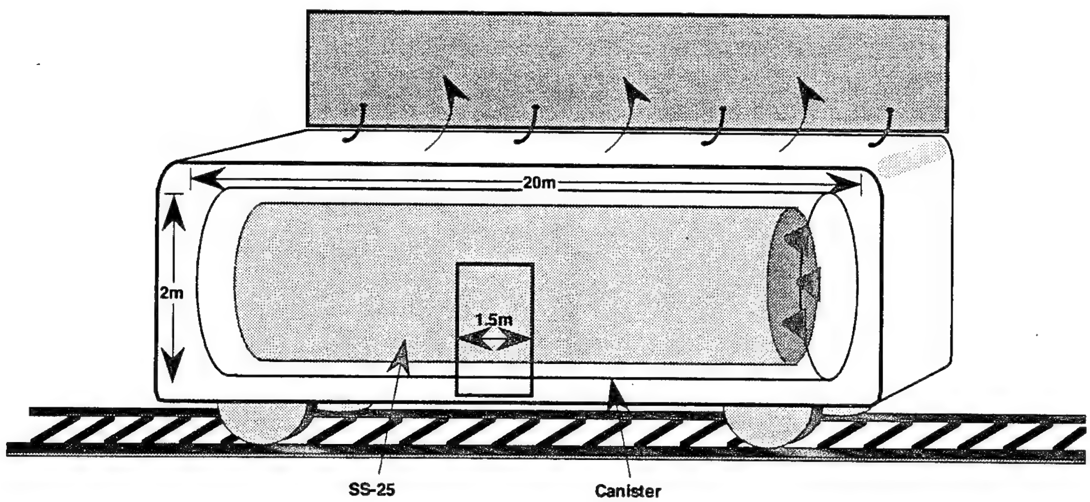


Figure A-4. Circumvention scenario no. 3: concealed access.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.13

CIRCUMVENTION SCENARIO (CS) NO. 4 **NICKNAME:** Rhineland

RANK:	19
TOTAL SCORE:	3.01
CS SCORE:	3.01
ITSIP VALUE:	0.00
TOSI VALUE:	0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The FSU decides to abrogate the treaty to convey a "Versailles message" to the U.S.

Monitors are arrested and bused off to the U.S. embassy for deportation.

We get very suspicious.

FEASIBILITY ISSUES: No significant issues.

INSPECTION PROTOCOL SEQUENCE: N/A

CATEGORY OF START AMBIGUITY:

- [X] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [X] Other Total Treaty Abrogation

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

[ ] High [ ] Medium [X] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

[ ] Emerging Democracy [X] Chaos [/] Oligarchy [/] Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

None

FEASIBILITY ISSUES: No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [X] No [ ] Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
[ ] X-ray	[ ] A.I.
[ ] Weight	[ ] NTM
[ ] Size Measurement	[ ] Other ________
[ ] Visual Observation	[ ] Other ________
[ ] Other ________	[ ] Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [ ] Yes [X] No

TREATY APPLICABILITY:

[ ] CWC/CW [ ] Open Skies [X] NPT [X] START Follow-on [ ] CFE [ ] Other ______

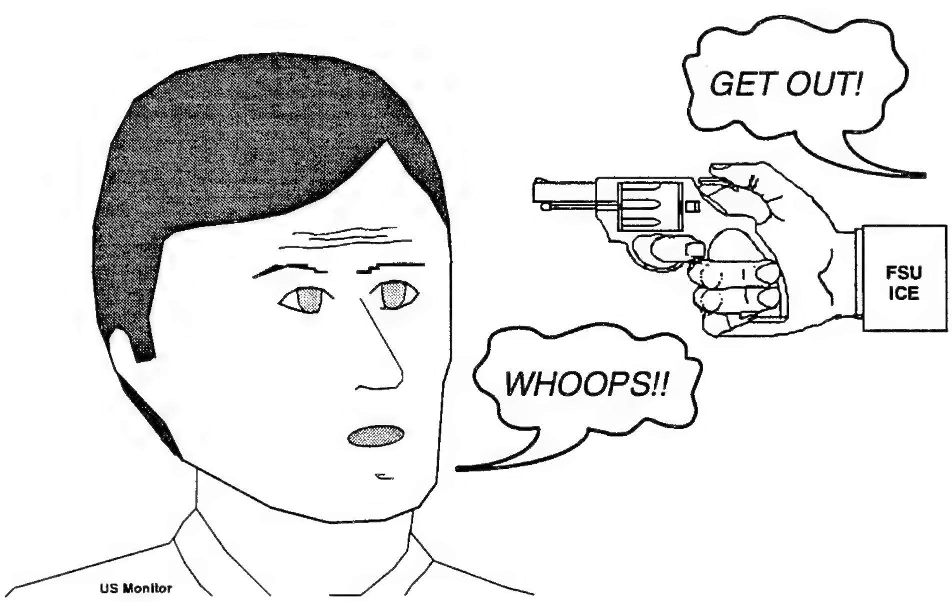


Figure A-5. Circumvention scenario no. 4: rhineland.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

94-0464.15

CIRCUMVENTION SCENARIO (CS) NO 5 **NICKNAME:** To err is human

RANK: 5
TOTAL SCORE: 7.01
CS SCORE: 3.01
ITSIP VALUE: 2.00
TOSI VALUE: 2.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

In conjunction with other circumvention techniques, a Russian circumvention strategy can be expected to exploit factors that degrade inspector performance such as weather, night, shift changes, personal relationships, and the patterns we establish. Techniques could include:

- developing a pattern of benign activity to mask a future violation.
- increasing traffic to stress inspectors (e.g., 1 railcar every 30 minutes for 48 hours.)
- use of behavior modifying chemicals (including alcohol)
- incidents that diverts attention from the portal

FEASIBILITY ISSUES: No significant issues

INSPECTION PROTOCOL SEQUENCE:
N/A

DETECTION TECHNIQUE DESCRIPTION:

1. Automate inspection protocol and procedures.
2. Make measurements as easy and automatic as possible - reduce handling data to a minimum
3. Track friendly performance to insure that we don't unconsciously fall into predictable patterns.
4. Careful exploitation of personal relationships.
5. Training and team building.

FEASIBILITY ISSUES:
No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [x] No [ ] Possibly

CATEGORY OF START AMBIGUITY:

- [x] Production Limit On Mobile ICBMs Exceeded
- [x] Undeclared New Variant Or Version
- [x] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other ____________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

[ ] High [ ] Medium [x] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

[ ] Emerging Democracy [x] Chaos
[x] Oligarchy [x] Russian Dictatorship

DETECTION METHODS

TOSI	NEW/SIMULATED
[ ] X-ray	[ ] A.I.
[ ] Weight	[ ] NTM
[ ] Size Measurement	[x] Other Automation
[ ] Visual Observation	[x] Other Perform. Trking
[ ] Other ________	[ ] Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [x] Yes [ ] No

TREATY APPLICABILITY:

[x] CWC/CW [x] Open Skies [x] NPT
[x] START Follow-on [x] CFE [ ] Other ______

Figure A-6. Circumvention scenario no. 5: to error is human.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.17

CIRCUMVENTION SCENARIO (CS) NO. 6 **NICKNAME:** Heavyweight

RANK: 7
TOTAL SCORE: 6.66
CS SCORE: 2.25
ITSIP VALUE: 3.00
TOSI VALUE: 1.41

CIRCUMVENTION TECHNIQUE DESCRIPTION:

A railcar with concealed weighting is provided to the portal monitors to calibrate weighing equipment for the weight of an empty car. A normal car with a complete SS-25 is then sent through the portal, and ICE specifies that the car is to be weighed. Because the difference with the calibrated weight is less than the weight of an assembled missile, the inspection ends and the car proceeds.

FEASIBILITY ISSUES: It may be difficult to line walls and floor of railcar with lead or other dense material without detection.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N6→N14→END

CATEGORY OF START AMBIGUITY:

- ■ Production Limit On Mobile ICBMs Exceeded
- □ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

□ High □ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

- □ Emerging Democracy
- ■ Chaos
- ◪ Oligarchy
- ◪ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Calibrated weight of the empty railcar could be compared by ITSIP against a nominal weight obtained in open sources or by other means. Deviations beyond the tolerable allowance for error would be indicated to the monitor, with a recommendation to request other railcars for weighing. Weighing device would be periodically recalibrated, with ITSIP keeping track of weights and car numbers to check for anomalies.

DETECTION METHODS

TOSI	NEW/SIMULATED
□ X-ray	■ A.I.
■ Weight	□ NTM
□ Size Measurement	■ Other Database
□ Visual Observation	□ Other________
□ Other________	□ Other________

FEASIBILITY ISSUES:

No significant issues.

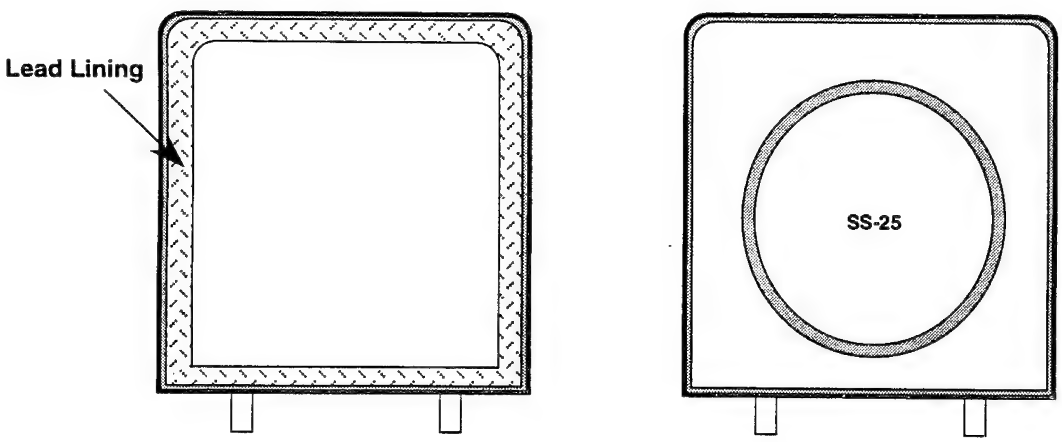
START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? □ Yes ■ No

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes ■ No □ Possibly

TREATY APPLICABILITY:

- □ CWC/CW
- □ Open Skies
- ■ NPT
- ■ START Follow-on
- □ CFE
- □ Other________



CALIBRATION RAIL-CAR **SHIPPING RAIL-CAR**

Figure A-7. Circumvention scenario no. 6: heavyweight.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

94-0464.18

CIRCUMVENTION SCENARIO (CS) NO. 7 **NICKNAME:** Degausser

RANK:	6
TOTAL SCORE:	7.01
CS SCORE:	3.01
ITSIP VALUE:	2.00
TOSI VALUE:	2.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

A small quantity of road-mobile SS-25 ICBMs are being produced for sale to a third country for hard cash. A fully assembled SS-25, in a launch canister, has been disguised and loaded in a railcar. The monitor notes the presence of a large unidentified container, and the ICE responds by inviting an X-ray scan. As the X-ray equipment is being initialized, the ICE places his briefcase, which contains a powerful magnet, close to ITSIP so that portions of the hard disk are erased. The X-ray scan software is corrupted and the procedure is inoperative. The ICE insists that the inspection requirements have been satisfied and the railcar exits.

FEASIBILITY ISSUES: Presence of the magnet may be noticed if other metal objects are attracted to the briefcase. Repeated equipment failures will quickly arouse the suspicion of the monitors.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:
- [x] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
[ ] High [ ] Medium [x] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- [ ] Emerging Democracy
- [x] Chaos
- [/] Oligarchy
- [/] Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

With ITSIP software corrupted, there is little that it will be able to do to help the inspector. (Firmware can be designed which will allow ITSIP to operate in a rudimentary mode. It would perform self-diagnostic tests similar to those used to detect software virus infections and indicate the failure to the inspector.)

FEASIBILITY ISSUES:
No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [ ] No [x] Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray	[ ] A.I.
[ ] Weight	[ ] NTM
[ ] Size Measurement	[ ] Other ______
[x] Visual Observation	[ ] Other ______
[ ] Other ______	[ ] Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [ ] Yes [x] No

TREATY APPLICABILITY:
[ ] CWC/CW [ ] Open Skies [x] NPT
[x] START Follow-on [ ] CFE [ ] Other______

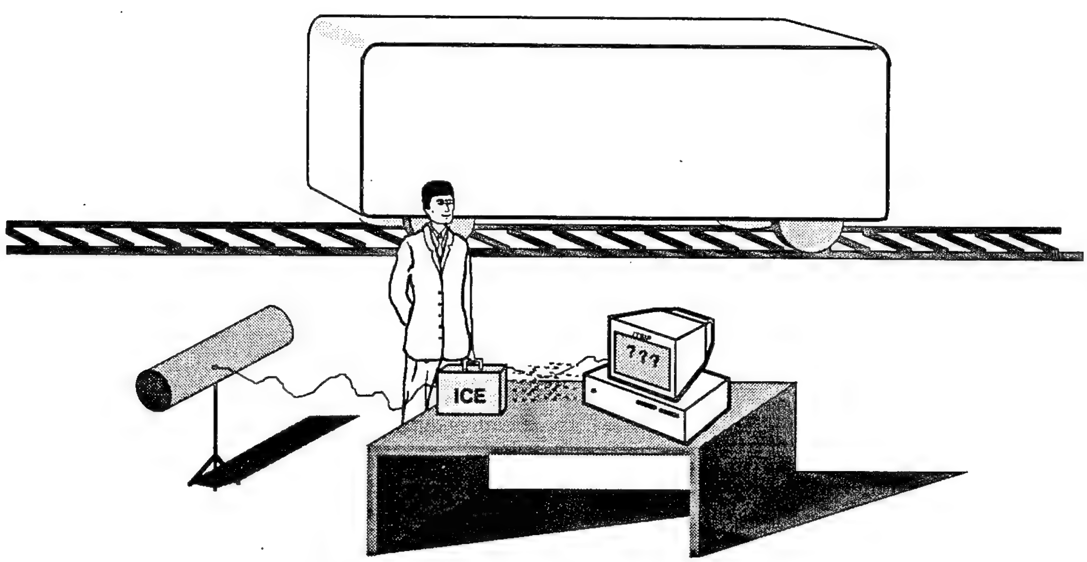


Figure A-8. Circumvention scenario no. 7: degausser.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

94-0464.20

CIRCUMVENTION SCENARIO (CS) NO. 8 **NICKNAME:** Offset Variant

RANK: 1
TOTAL SCORE: 10.51
CS SCORE: 3.51
ITSIP VALUE: 3.00
TOSI VALUE: 4.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The ICE claims that a new variant of the SS-24 will be produced which is intended for space use and is therefore exempt from START ceilings. The SS-24 variant will have a first stage diameter 10% greater than that of the baseline mobile SS-24.

In fact, an unmodified SS-24, assembled and contained in a launch canister, is loaded in a railcar which arrives at the portal. The SS-24 has been offset to one side of the railcar to result in a reading of larger apparent diameter when an X-ray trace is performed. The off-center launch canister is concealed by a larger container which appears to be centered. The ICE elects non-damaging imaging of the canister.

FEASIBILITY ISSUES: No significant issues.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:
- ☒ Production Limit On Mobile ICBMs Exceeded
- ☒ Undeclared New Variant Or Version
- ☒ Increase In Throw-weight
- ☐ Increase In Warhead Loading
- ☐ Other________________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
☐ High ☐ Medium ☒ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- ☐ Emerging Democracy
- ☒ Chaos
- ◩ Oligarchy
- ◩ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

The inspector notes that it is unusual for an SS-24 to be shipped in a container other than a launch canister and enters this observation into ITSIP. ITSIP will recommend that the monitor request ICE permission to view the interior of the container, which will be denied. At this point the inspector may be suspicious but will be obligated to allow the rail-car to exit. (If strain gauges were inserted in the rails they would indicate the asymmetry of the load.)

FEASIBILITY ISSUES:
No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ☒ Yes ☐ No ☐ Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
☒ X-ray	☐ A.I.
☐ Weight	☐ NTM
☐ Size Measurement	☒ Other Strain Gauge
☒ Visual Observation	☐ Other ________
☐ Other ________	☐ Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ☒ Yes ☐ No

TREATY APPLICABILITY:
- ☐ CWC/CW
- ☐ Open Skies
- ☒ NPT
- ☒ START Follow-on
- ☐ CFE
- ☐ Other______

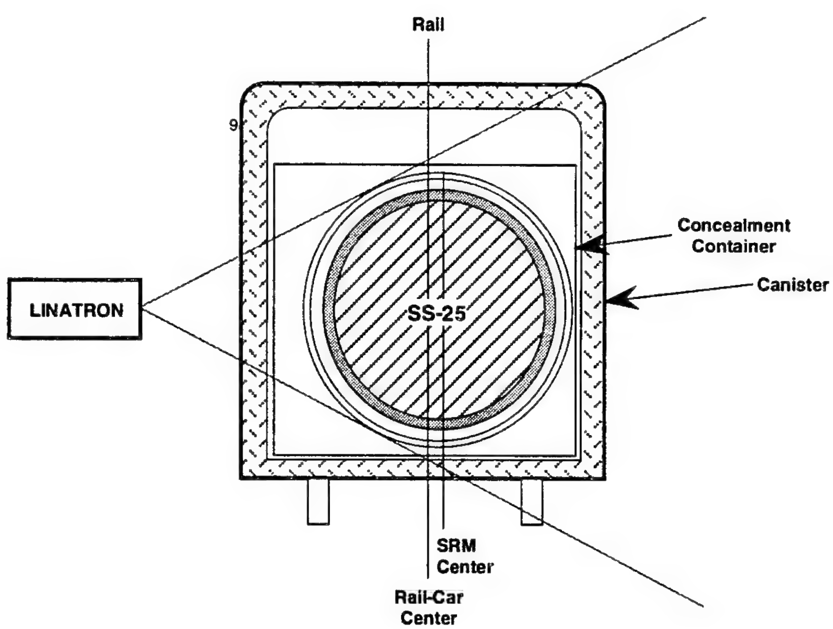


Figure A-9. Circumvention scenario no. 8: offset variant.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.22

CIRCUMVENTION SCENARIO (CS) NO. 8a **NICKNAME:** Offset Variant Plus

RANK: 2
TOTAL SCORE: 10.51
CS SCORE: 3.51
ITSIP VALUE: 3.00
TOSI VALUE: 4.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The ICE claims that a new tactical missile-smaller than the SS-25 and not constrained by the START or INF Treaties-is being built at Votkinsk. The missile, assembled and transported in a launch canister, is loaded in a railcar that arrives at the portal. The missile has been offset to the side of the car away from the linatron X-ray source, but is packed in the large crate that conceals its positioning within the car. The ICE allows the car to be X-rayed. The image produced reveals the profile of a missile that is smaller than an SS-25.

FEASIBILITY ISSUES: None.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:

- ■ Production Limit On Mobile ICBMs Exceeded
- □ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other ________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

□ High □ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

□ Emerging Democracy ◩ Chaos
■ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

The inspector notes that it is unusual for an SS-25 to be shipped in a container other than a launch canister and enters this observation into ITSIP. ITSIP will recommend that the monitor request ICE permission to view the interior of the container, which will be denied. The inspector will be suspicious but will be obligated to allow the railcar to exit. (If strain gauges were attached to the rails, they would indicate the asymmetry of the load.) ITSIP will note that the inspector can recommend to his superiors that the question of a new missile-not contained in its database-which might be a strategic offensive weapon be clarified by the Joint Compliance and Inspection Commission.

FEASIBILITY ISSUES:
None

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ■ Yes □ No □ Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
□ Weight	□ NTM
□ Size Measurement	■ Other Strain Gauge
■ Visual Observation	□ Other ________
□ Other ________	□ Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ■ Yes □ No

TREATY APPLICABILITY:

□ CWC/CW □ Open Skies □ NPT
■ START Follow-on □ CFE □ Other ______

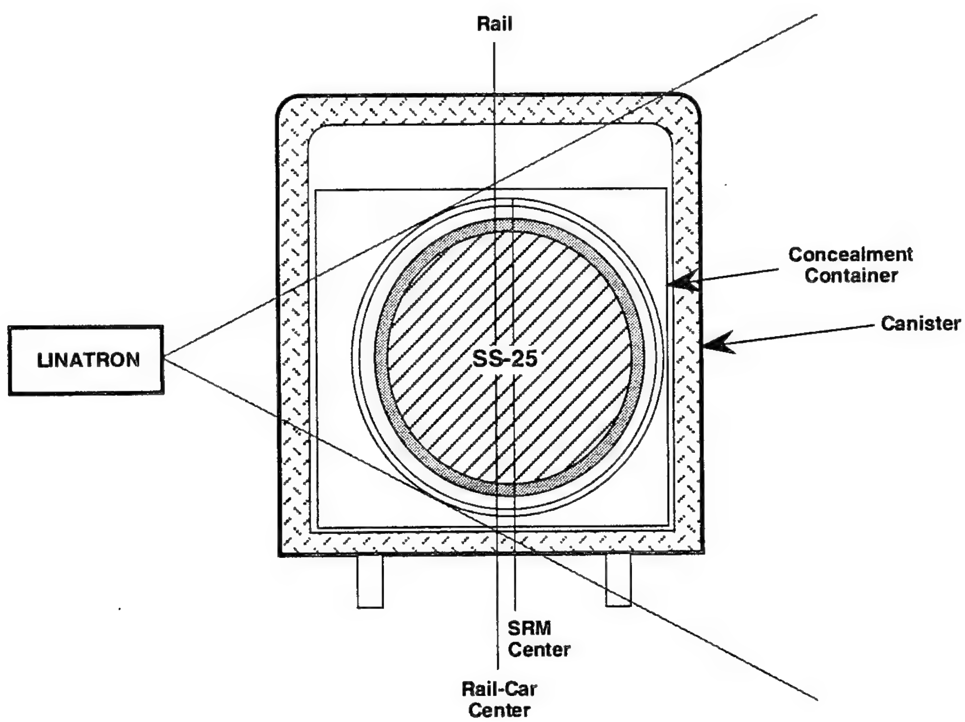


Figure A-10. Circumvention scenario no. 8a: offset variant plus.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.24

CIRCUMVENTION SCENARIO (CS) NO. 9 **NICKNAME:** Piecemeal

RANK: 10
TOTAL SCORE: 6.06
CS SCORE: 1.24
ITSIP VALUE: 2.00
TOSI VALUE: 2.83

CIRCUMVENTION TECHNIQUE DESCRIPTION:

Production of SS-24s is increased well beyond the numerical limits allowed by START at the missile production facility.

Canisters are used that allow the stages of each missile, with nozzles attached, to be shipped separately in rail-cars to a covert assembly plant.

Inspectors are cordially invited to inspect the interior of each rail-car leaving the facility. Of course, none contain any "containers large enough to contain an ICM" (18 meters long).

FEASIBILITY ISSUES:

Covert building or re-tooling of a new assembly facility is required.

INSPECTION PROTOCOL SEQUENCE:

P1→P3→I→N1→N3→N5→N16→N18→N20→N22→G→END

CATEGORY OF START AMBIGUITY:

- [x] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other____________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

- [ ] High
- [ ] Medium
- [x] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

- [x] Emerging Democracy
- [x] Chaos
- [/] Oligarchy
- [/] Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

The inspector enters the dimensions of the containers he observed. ITSIP checks its database on missile and stage dimensions and then warns the inspector that the containers could contain stages of mobile ICBMs. (In addition, if weighing is permitted, weight of the rail-car would reveal that it is heavy enough to contain an SS-24 stage. ITSIP would alert inspectors to this possibility.) ITSIP would suggest that the monitor consider a challenge. When this is done, the Inspection Protocol steps taken are DD, CC1, CC3, CC5, END. ITSIP interprets the X-ray scan and indicates a high probability that the container holds an SS-24 SRM. If weight measurement is not allowed, the five challenge inspections may be quickly exhausted.

FEASIBILITY ISSUES:

No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [ ] No [x] Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray	[ ] A.I.
[x] Weight	[ ] NTM
[x] Size Measurement	[ ] Other ________
[ ] Visual Observation	[ ] Other ________
[ ] Other ________	[ ] Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [x] Yes [ ] No

TREATY APPLICABILITY:

- [ ] CWC/CW
- [ ] Open Skies
- [x] NPT
- [x] START Follow-on
- [ ] CFE
- [ ] Other ______

Figure A-11. Circumvention scenario no. 9: peacemeal.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.25

CIRCUMVENTION SCENARIO (CS) NO. 10 **NICKNAME:** Piecemeal Plus

RANK: 14
TOTAL SCORE: 4.98
CS SCORE: 1.98
ITSIP VALUE: 3.00
TOSI VALUE: 0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

To circumvent continuous monitoring of SS-25 assembly at Votkinsk, stages are shipped separately in shipping containers from Votkinsk in vehicles that are not "large enough to contain an ICM." Stages were shipped into Votkinsk from a production facility and prepared for assembly but not assembled, alternatively, they could have been produced at Votkinsk after tooling up for that process.

FEASIBILITY ISSUES:
Construction of a covert assembly facility elsewhere and/or retooling of Votkinsk to produce SRM's is required.

INSPECTION PROTOCOL SEQUENCE:
R1→R3→END

CATEGORY OF START AMBIGUITY:
- [x] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other______________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
[ ] High [x] Medium [ ] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- [x] Emerging Democracy
- [ ] Chaos
- [x] Oligarchy
- [ ] Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Traffic analysis by ITSIP could identify suspicious patterns of traffic in and/or out of Votkinsk. Present protocol does not permit inspection to verify presence of SS-25 first stages. With modification of protocol to allow challenge procedures for SS-25 first stages, detection procedures for scenario 1 at Pavlograd could apply.

FEASIBILITY ISSUES:
Traffic analysis with an AI capability would require large amounts of data that are currently unavailable to system designers.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [x] Yes [ ] No [ ] Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray (if permitted)	[x] A.I.
[x] Weight (if permitted)	[ ] NTM
[x] Size Measurement	[ ] Other________
[ ] Visual Observation	[ ] Other________
[ ] Other________	[ ] Other________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [ ] Yes [x] No

TREATY APPLICABILITY:
- [ ] CWC/CW
- [ ] Open Skies
- [x] NPT
- [x] START Follow-on
- [ ] CFE
- [ ] Other______

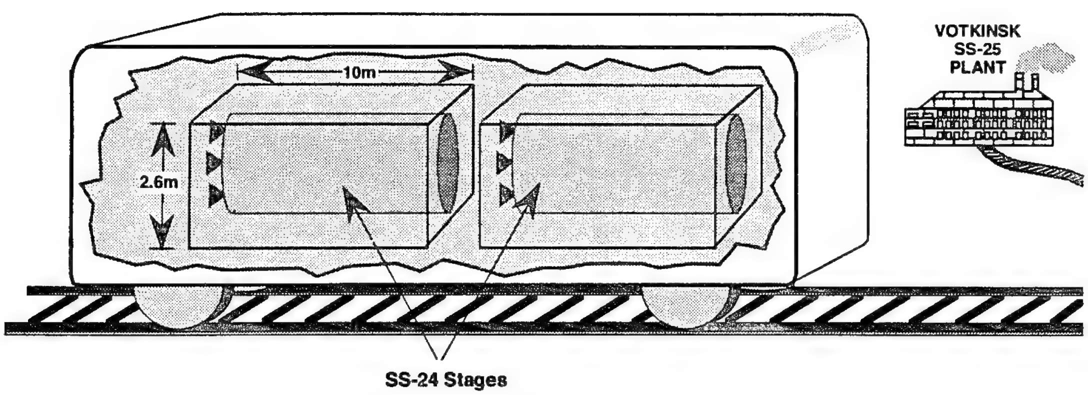


Figure A-12. Circumvention scenario no. 10: peacemeal plus.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.27

CIRCUMVENTION SCENARIO (CS) NO. 11 **NICKNAME:** False Shell

RANK: 8
TOTAL SCORE: 6.41
CS SCORE: 2.00
ITSIP VALUE: 3.00
TOSI VALUE: 1.41

CIRCUMVENTION TECHNIQUE DESCRIPTION:

SS-24s (rail-mobile) are being assembled in excess of the numerical treaty limitations (125) on non-deployed rail-mobile ICBMS. The SS-24s are placed inside shells fabricated in the same dimensions as a new version of the SS-18 which has been fabricated for space use and previously declared. Thus the SS-24s appear visually to be SS-18s. The ICE declares that the portal inspectors may view the "SS-18X" from the end of the "SS-18X launch canister."

CATEGORY OF START AMBIGUITY:

- [x] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other ______

FEASIBILITY ISSUES:
No significant issues.

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

- [ ] High
- [x] Medium
- [ ] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

- [x] Emerging Democracy
- [ ] Chaos
- [x] Oligarchy
- [x] Russian Dictatorship

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N18→N19→E→L2→L6→END

DETECTION TECHNIQUE DESCRIPTION:

ITSIP becomes suspicious because its database indicates that production of SS-18Xs, is extremely rare. ITSIP recommends that the monitor request permission from ICE to weigh the railcar. If permission is granted, the weight may be inconsistent with the ITSIP calculated weight of an empty SS-18X. ITSIP also recommends that the monitor request permission from ICE to X-ray the canister. If this is allowed, it will show a missile SRM casing diameter inconsistent with an SS-18X and consistent with an SS-24. Denial of permission to perform these procedures will increase the suspicion of ITSIP.

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray	[ ] A.I.
[x] Weight	[ ] NTM
[x] Size Measurement	[x] Other Production History ~~Database~~
[x] Visual Observation	[x] Other ~~ICE Behavior~~
[ ] Other ______	[ ] Other Database

FEASIBILITY ISSUES:
No significant issues.

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [ ] Yes [x] No

TREATY APPLICABILITY:

- [ ] CWC/CW
- [ ] Open Skies
- [x] NPT
- [x] START Follow-on
- [ ] CFE
- [ ] Other ______

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [ ] No [x] Possibly

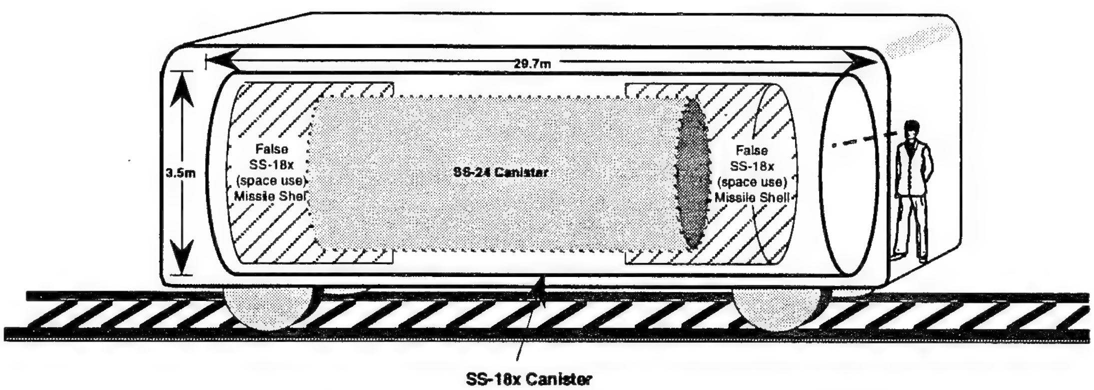


Figure A-13. Circumvention scenario no. 11: false shell.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.29

CIRCUMVENTION SCENARIO (CS) NO. 12 **NICKNAME:** Tunnel

RANK: 12
TOTAL SCORE: 5.14
CS SCORE: 1.73
ITSIP VALUE: 2.00
TOSI VALUE: 1.41

CIRCUMVENTION TECHNIQUE DESCRIPTION:

Mobile SS-24s and SS-25s are being produced in violation of treaty ceilings. The missiles are shipped, fully assembled and enclosed in canisters, via an underground tunnel which bypasses the portal. The tunnel has been started from outside the facility so that excavated material does not accumulate within it.

FEASIBILITY ISSUES:
Ability to construct and use tunnel without detection by NTM or human sources would be very challenging.

INSPECTION PROTOCOL SEQUENCE:
N/A

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- ■ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other ______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
□ High ■ Medium □ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
■ Emerging Democracy □ Chaos
■ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Seismic sensors, if added to the list of allowed equipment for the perimeter and portal continuous monitoring system, can detect vibration due to the passage of cargo underground and/or construction of a tunnel and alert the monitors. An array of seismic sensors will be able to locate the general area of the vibration, and monitors may be able to visually verify that no above ground activity consistent with the vibration is occurring. NTM may also be able to identify an exterior exit from a tunnel or vehicles using such an exit.

FEASIBILITY ISSUES: Seismic sensors are inexpensive and fairly easy to integrate. However, the inspected party could stage an apparent source of seismic disturbance to mask the vibrations from the tunnel.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
□ X-ray	□ A.I.
□ Weight	■ NTM
□ Size Measurement	■ Other Seismic
■ Visual Observation	□ Other ______
□ Other ______	□ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? □ Yes ■ No

TREATY APPLICABILITY:
□ CWC/CW □ Open Skies ■ NPT
■ START Follow-on □ CFE □ Other ______

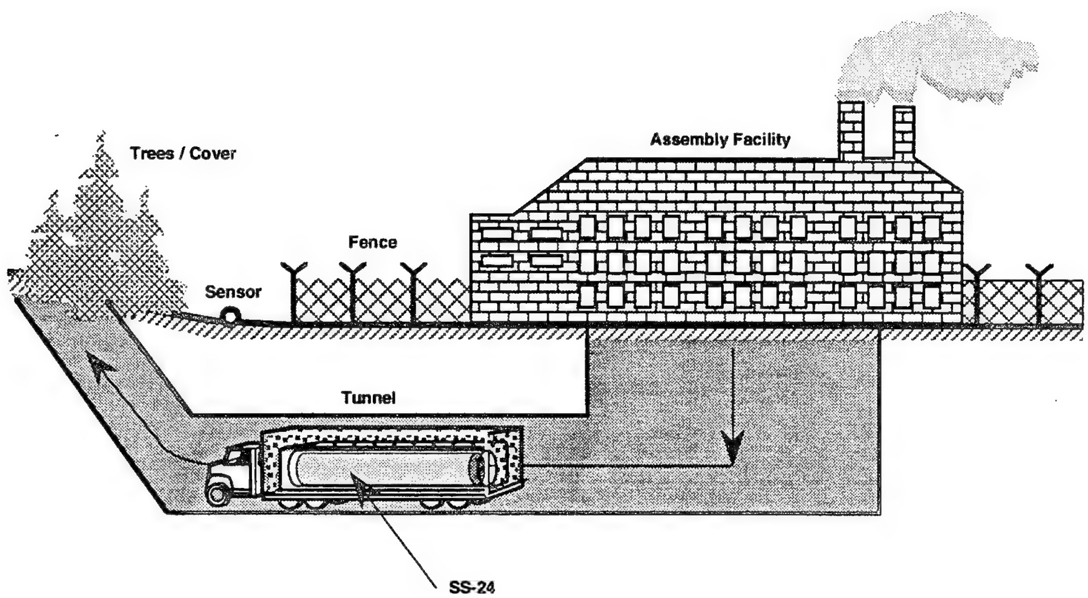


Figure A-14. Circumvention scenario no. 12: tunnel.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.31

CIRCUMVENTION SCENARIO (CS) NO. 13 **NICKNAME:** Empty Stage

RANK: 21
TOTAL SCORE: 2.48
CS SCORE: 1.48
ITSIP VALUE: 1.00
TOSI VALUE: 0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

SS-24 stage casings without propellant are being produced and shipped, from a monitored facility to a covert facility where they will be cartridge loaded with propellant. The ICE elects to have the vehicle weighed at the portal. The weight is too low for the vehicle to contain a ICM.

FEASIBILITY ISSUES: The logistical benefit in shipping empty SRM casings is questionable. In addition, covert construction or retooling and covert operation of an SS-24 propellant loading and assembly facility is required and would be technically challenging.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N6→N14→END

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- □ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other__________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
□ High ■ Medium □ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
■ Emerging Democracy □ Chaos
■ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

ITSIP recommends that the monitor request permission of the ICE to view the interior of the vehicle. Likewise, ITSIP would suggest that the monitor ask for permission to X-ray the vehicle. If these procedures are permitted, the possibility of an ICM component being present will be indicated. However, it is likely that permission will be denied in this scenario. Since the weight measured is too low for the railcar to contain even a loaded first stage of an SS-24, ITSIP will recommend avoiding the use of a challenge inspection.

If the CS occurs as described above, unambiguous detection will not be accomplished. ITSIP could note, however, that the weight is the approximate weight of a empty SRM.

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
■ Weight	□ NTM
□ Size Measurement	■ Other Database
■ Visual Observation	□ Other _____
□ Other _____	□ Other _____

START INSPECTION TYPE: Continuous Monitoring

FEASIBILITY ISSUES:
Full exposure, due to protocol structure, will probably not be accomplished.

TESTABLE AT TOSI? ■ Yes □ No

TREATY APPLICABILITY:
□ CWC/CW □ Open Skies ■ NPT
■ START Follow-on □ CFE □ Other _____

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ■ Yes □ No □ Possibly

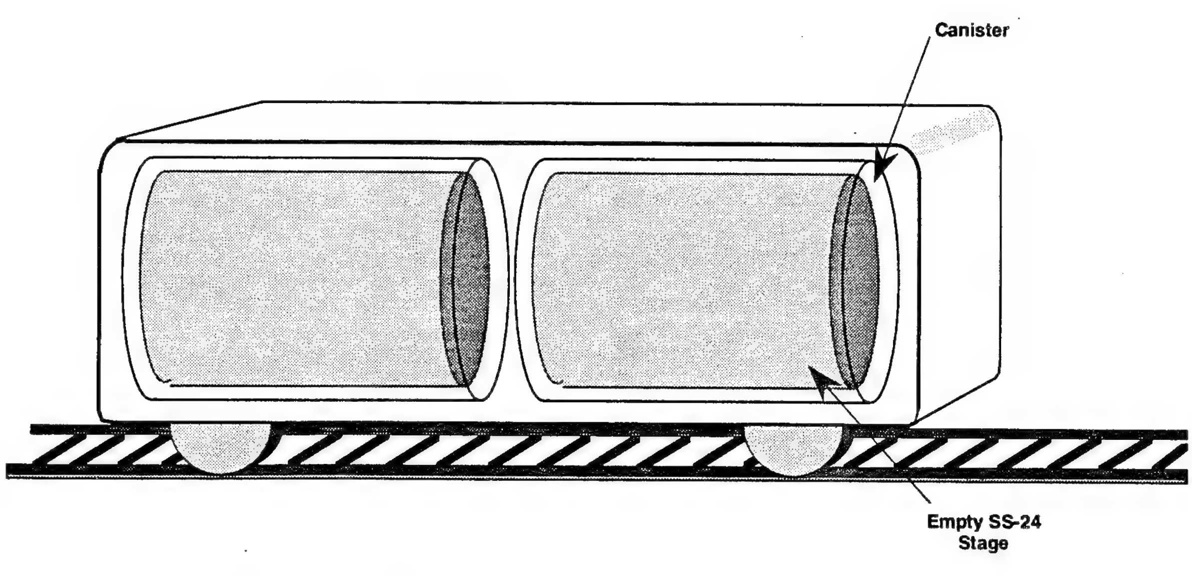


Figure A-15. Circumvention scenario no. 13: empty stage.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.33

CIRCUMVENTION SCENARIO (CS) NO. 14 **NICKNAME:** Breakout Stockpile

RANK: 13
TOTAL SCORE: 4.99
CS SCORE: 1.99
ITSIP VALUE: 3.00
TOSI VALUE: 0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

Mobile ICBMs, of both SS-24 and SS-25 type, are produced in large numbers in violation of treaty ceilings, assembled, and stored in a concealed location underneath or within the assembly facility.

At the appropriate time the treaty is abrogated and all missiles are rapidly shipped to deployment sites.

FEASIBILITY ISSUES:
1. Availability of space within existing missile assembly plants.
2. Safety of mass missile storage.

INSPECTION PROTOCOL SEQUENCE:
N/A

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ☐ Undeclared New Variant Or Version
- ☐ Increase In Throw-weight
- ☐ Increase In Warhead Loading
- ☐ Other_______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
☐ High ■ Medium ☐ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
■ Emerging Democracy ☐ Chaos
■ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Monitors located at rail portals and road exits keep track of the length and height (as indicated by an enhanced infrared break-beam system) of each vehicle entering, as well as leaving, the plant. In addition, a human operator interprets the video display of ITSIP to enter "vehicle type."

In this breakout scenario, the database on the workstation may detect a significantly increased volume of raw material and large vehicles entering the plant with no corresponding reduction in outgoing shipments.

ITSIP cues inspectors to the possibility of covert missile production and storage, and suggests that a Special Access Visit be requested at the facility.

FEASIBILITY ISSUES:
Distinguishing the increase in traffic flow due to covert missile production from ordinary variations in the flow may be difficult.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ☐ Yes ■ No ☐ Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
☐ X-ray	■ A.I.
☐ Weight	☐ NTM
■ Size Measurement	☐ Other ____
■ Visual Observation	☐ Other ____
☐ Other ____	☐ Other ____

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ☐ Yes ■ No

TREATY APPLICABILITY:
■ CWC/CW ☐ Open Skies ■ NPT
■ START Follow-on ☐ CFE ☐ Other ____

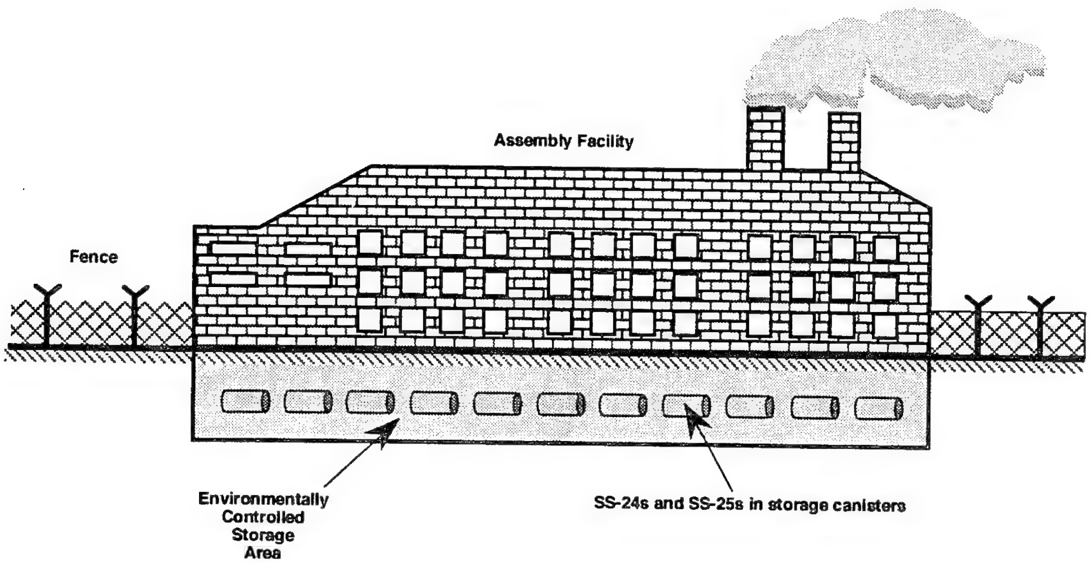


Figure A-16. Circumvention scenario no. 14: breakout stockpile.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0454.35

CIRCUMVENTION SCENARIO (CS) NO. 15 **NICKNAME:** Tesla Coil

RANK: 22
TOTAL SCORE: 2.26
CS SCORE: 2.26
ITSIP VALUE: 0.00
TOSI VALUE: 0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

A small quantity of rail-mobile SS-24 ICBMs are being produced for sale to a third country for hard cash. An SS-24, enclosed in a launch canister, is concealed in a very large container in a railcar. The monitor sees the container and notes that it appears to be large enough to contain an ICM. The ICE elects to have the container X-rayed. As the X-ray equipment is being initialized, the ICE enters the portal workstation room with a Tesla coil device enclosed in a suitcase. The device generates an electromagnetic pulse of sufficient strength to permanently disable the semiconductors in ITSIP. The X-ray scan will not operate, but the ICE insists that the inspection requirements have been satisfied; the railcar exits.

FEASIBILITY ISSUES: This technique will immediately generate suspicion on the part of the monitors. Failure analysis, if performed on the electronic components, will indicate the cause of failure.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:
- [x] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other ____________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
[ ] High [x] Medium [ ] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- [x] Emerging Democracy
- [ ] Chaos
- [x] Oligarchy
- [x] Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

When ITSIP is inoperative, there is nothing it can do to help the inspector.

(A high level of resistance to electromagnetic pulse damage could probably be designed into ITSIP; or a special EMP detector could be included in the workstation room.)

FEASIBILITY ISSUES:

No significant issues

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [ ] No [x] Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray	[ ] A.I.
[ ] Weight	[ ] NTM
[ ] Size Measurement	[ ] Other ________
[x] Visual Observation	[ ] Other ________
[ ] Other ________	[ ] Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [ ] Yes [x] No

TREATY APPLICABILITY:
- [ ] CWC/CW
- [ ] Open Skies
- [x] NPT
- [x] START Follow-on
- [ ] CFE
- [ ] Other ______

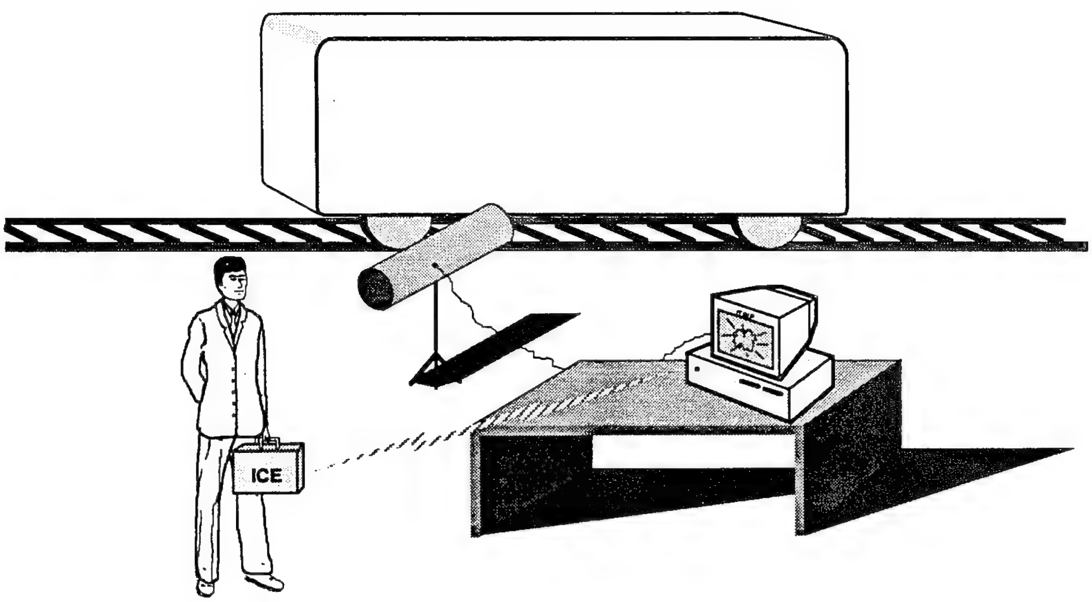


Figure A-17. Circumvention scenario no. 15: telsa coil.

CIRCUMVENTION SCENARIO (CS) NO. 16 **NICKNAME:** Up-Stage

RANK:	17
TOTAL SCORE:	4.58
CS SCORE:	0.58
ITSIP VALUE:	2.00
TOSI VALUE:	2.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The payload capability of the SS-25 has been increased by enlarging the diameter of the first stage from 1.8 to 2.1 meters, and loading more solid propellant. The modified SS-25 will deliver 3 RVs with no decrease in range. In order to avoid detection of this new type of missile, it has been packed into a canister for an SS-19. The ICE declares that SS-19s will now be produced at this facility. A false SS-19 "shell" has been placed over one end of the undeclared SS-25 modification.

FEASIBILITY ISSUES:
Flight testing of the SS-25 variant will be extremely difficult to conceal. If no flight tests are conducted, reliability would be called into question.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N18→N19→E→L2→L6→END

DETECTION TECHNIQUE DESCRIPTION:
The apparent production of an SS-19 will be inconsistent with the missile production trends stored in the ITSIP database. ITSIP will cue the inspector to request weighing of the vehicle. If the rail-car can be weighed, it will be observed that the vehicle is too heavy to contain an empty (unfueled) SS-19. ITSIP may also suggest that the monitor request ICE permission to X-ray the vehicle. An X-ray scan of the rail-car will show the rocket motor of 2.1 meters diameter. This is too small to be an SS-19, so the workstation will indicate the likely presence of an unknown type of solid-fueled missile. Denial of permission to perform these additional procedures, especially if inconsistent with previous ICE behavior, will cause ITSIP to suggest a possible circumvention and ambiguity.

FEASIBILITY ISSUES:
No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [ ] No [x] Possibly

CATEGORY OF START AMBIGUITY:
- [ ] Production Limit On Mobile ICBMs Exceeded
- [x] Undeclared New Variant Or Version
- [x] Increase In Throw-weight
- [x] Increase In Warhead Loading
- [ ] Other ________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
[x] High [ ] Medium [ ] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
[x] Emerging Democracy [ ] Chaos
[ ] Oligarchy [x] Russian Dictatorship

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray	[x] A.I.
[x] Weight	[ ] NTM
[x] Size Measurement	[ ] Other ______
[x] Visual Observation	[ ] Other ______
[ ] Other ______	[ ] Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [x] Yes [ ] No

TREATY APPLICABILITY:
[ ] CWC/CW [ ] Open Skies [x] NPT
[x] START Follow-on [ ] CFE [ ] Other ______

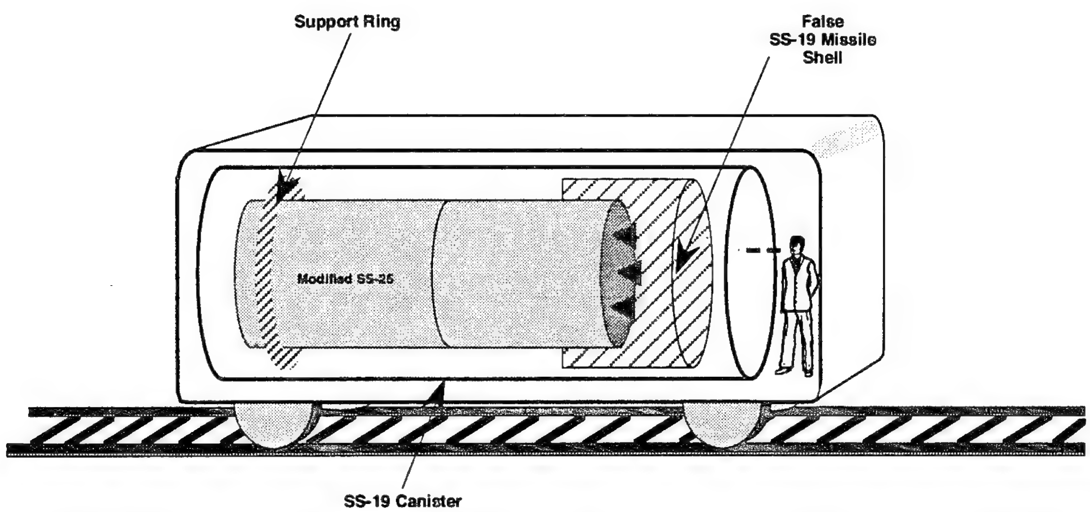


Figure A-18. Circumvention scenario no. 16: up-stage.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

CIRCUMVENTION SCENARIO (CS) NO. 17 **NICKNAME:** X-Ray Dupe

RANK: 20
TOTAL SCORE: 2.87
CS SCORE: 0.87
ITSIP VALUE: 2.00
TOSI VALUE: 0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

A fully assembled SS-24 has been loaded into a specially equipped rail-car which contains an elaborate apparatus for avoiding detection by X-ray. A sensor inside the rail-car detects the timing and position of the incoming X-ray stream, which is absorbed in short lead plates on either side of the SS-24. The sensor activates a second X-ray generator inside the rail-car which propagates a simulated normal signal to the X-ray detectors. The entire apparatus, including the SS-24, is contained in a "container" which the ICE elects to have X-rayed.

FEASIBILITY ISSUES: 1. Design, production, and testing of this apparatus to accommodate slight changes in inspection procedure or parameters will be quite challenging. 2. A high capacity power source is required on the railcar.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

DETECTION TECHNIQUE DESCRIPTION:

The suspicion of the inspector is aroused when he sees the size of the container and he enters its approximate size into ITSIP. At this point ITSIP suggests to the monitor that the railcar be weighed; however, the ICE declines, electing the X-ray procedure. The X-ray scan shows little apparent absorption by the contents of the large container.

ITSIP is suspicious of the large container and also of the decision of the ICE to elect a tedious procedure and it recommends that the X-ray scan be rerun with slightly adjusted parameters. ITSIP can also recommend varying the point of X-ray sampling on the container. Close analysis by ITSIP will then reveal the synthesized nature of the received signal.

FEASIBILITY ISSUES:
Capability to adjust parameters must be designed into the X-ray system and ITSIP.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- □ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other____________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
■ High □ Medium □ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
◩ Emerging Democracy □ Chaos
□ Oligarchy ■ Russian Dictatorship

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
■ Weight	□ NTM
■ Size Measurement	□ Other ________
■ Visual Observation	□ Other ________
□ Other ________	□ Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? □ Yes ■ No

TREATY APPLICABILITY:
□ CWC/CW □ Open Skies ■ NPT
■ START Follow-on □ CFE □ Other ______

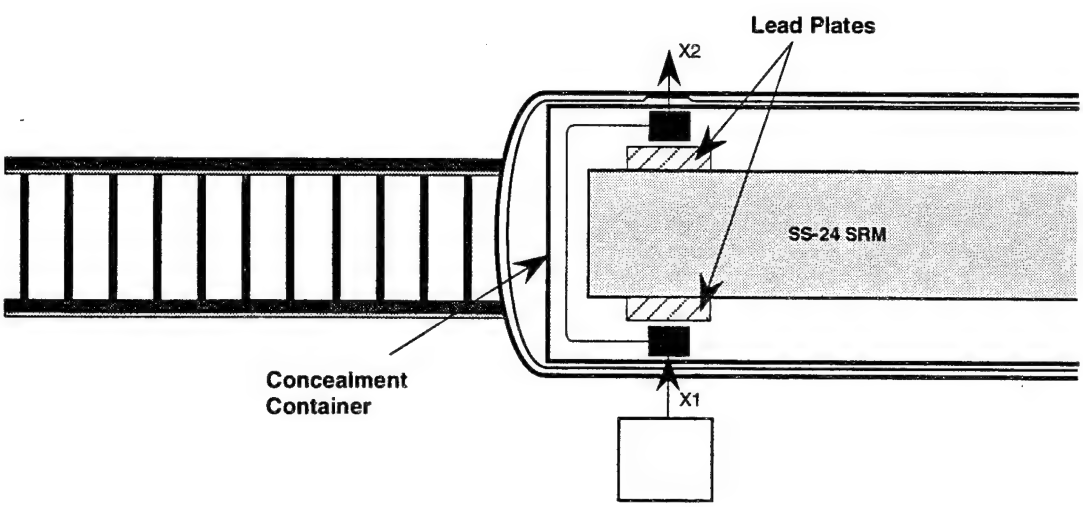


Figure A-19. Circumvention scenario no. 17: x-ray dupe.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.41

CIRCUMVENTION SCENARIO (CS) NO. 18 **NICKNAME:** Split Stage

RANK:	16
TOTAL SCORE:	4.73
CS SCORE:	1.73
ITSIP VALUE:	3.00
TOSI VALUE:	0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

A new mobile ICBM, the SS-30, is designed which uses four stages filled with solid propellant. The advantage in doing this is that all of the four stages are shorter than 8.3 meters in length and are thus immune to inspection, even at portals of facilities where MIRVed mobile ICBMs are produced. The containers may be shipped from a road exit or the portal exit.

FEASIBILITY ISSUES: 1. Flight testing required of the new missile type will be extremely difficult to conceal. 2. There is not a clear benefit from performing this technique since production facilities for single warhead mobile ICBMs are not subject to inspection for single missile stages.

INSPECTION PROTOCOL SEQUENCE:
R→R3→END or P→P3→I→N2→N7→END

CATEGORY OF START AMBIGUITY:
- ☐ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- ☐ Increase In Throw-weight
- ☐ Increase In Warhead Loading
- ☐ Other__________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
■ High ☐ Medium ☐ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
◩ Emerging Democracy ☐ Chaos
☐ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Without a change in inspection protocol which permitted weighing and/or X-ray examination of all vehicles exiting a facility, this circumvention would go undetected.

ITSIP analysis of inspector entered data on traffic flow and composition for entering and exiting vehicles may provide indications of unexplained variations.

FEASIBILITY ISSUES:
Distinguishing the increase in traffic flow due to covert missile production from ordinary variations in the flow may be difficult.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ■ Yes ☐ No ☐ Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
☐ X-ray	■ A.I.
☐ Weight	☐ NTM
■ Size Measurement	☐ Other ______
■ Visual Observation	☐ Other ______
☐ Other ______	☐ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ☐ Yes ■ No

TREATY APPLICABILITY:
☐ CWC/CW ☐ Open Skies ■ NPT
■ START Follow-on ☐ CFE ☐ Other ______

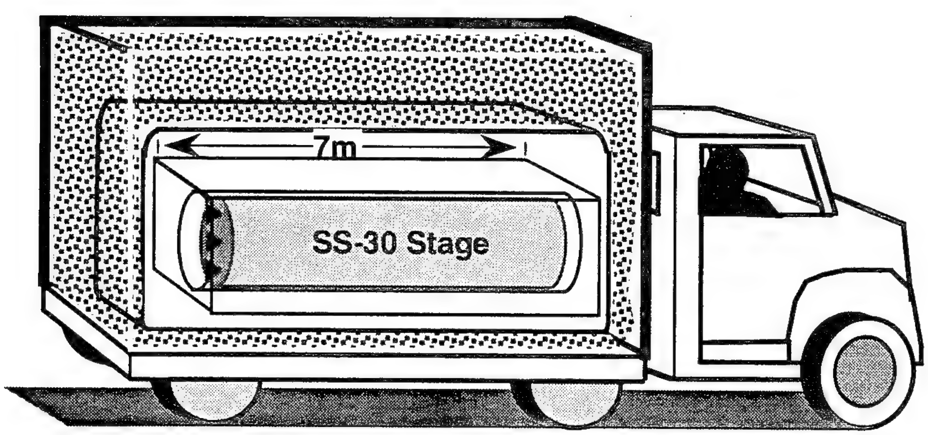


Figure A-20. Circumvention scenario no. 18: split stage.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.43

CIRCUMVENTION SCENARIO (CS) NO. 19 **NICKNAME:** Bait and Switch

RANK: 23
TOTAL SCORE: 2.15
CS SCORE: 2.15
ITSIP VALUE: 0.00
TOSI VALUE: 0.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

An otherwise unmodified SS-25 is loaded with 3 RV's outside the production facility. Performance parameters extrapolated from SS-25 and SS-24 flight testing.

FEASIBILITY ISSUES: Without flight testing, the performance of the modified SS-25 would be uncertain; Flight testing, if performed, would be difficult to conceal. Circumvention of RV inspection is also required.

INSPECTION PROTOCOL SEQUENCE:

N/A (For Portal).

CATEGORY OF START AMBIGUITY:

- ☐ Production Limit On Mobile ICBMs Exceeded
- ☐ Undeclared New Variant Or Version
- ☐ Increase In Throw-weight
- ■ Increase In Warhead Loading
- ☐ Other______________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

■ High ☐ Medium ☐ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

◩ Emerging Democracy ☐ Chaos
☐ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

Not detectable by portal monitoring. Use radiation detection equipment during RV inspections of deployed ICBM's under the provisions of para 6, Article XI of the Treaty.

DETECTION METHODS

TOSI	NEW/SIMULATED
☐ X-ray	☐ A.I.
☐ Weight	☐ NTM
☐ Size Measurement	■ Other Visual
☐ Visual Observation	☐ Other ________
☐ Other ________	☐ Other ________

START INSPECTION TYPE: RV Inspection

TESTABLE AT TOSI? ☐ Yes ■ No

FEASIBILITY ISSUES:

No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ☐ Yes ■ No ☐ Possibly

TREATY APPLICABILITY:

☐ CWC/CW ☐ Open Skies ☐ NPT
■ START Follow-on ☐ CFE ☐ Other ______

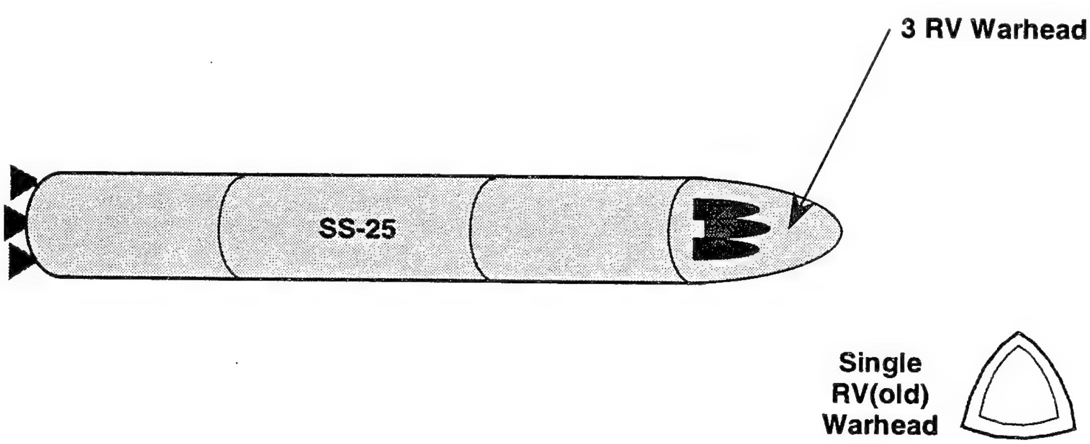


Figure A-21. Circumvention scenario no. 19: bait and switch.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.45

CIRCUMVENTION SCENARIO (CS) NO. 20 **NICKNAME:** Shell Tool

RANK: 9
TOTAL SCORE: 6.28
CS SCORE: 2.87
ITSIP VALUE: 2.00
TOSI VALUE: 1.41

CIRCUMVENTION TECHNIQUE DESCRIPTION:

FSU decides to sell vast quantities of SS-24s (slightly modified) for hard cash. A fiberglass shell is constructed which appears to be a large machine tool. ICE declares that the factory is being converted to producing these new tools. An SS-24 is hidden within. The ICE allows the monitor to view the interior of the railcar and to view and measure the "machine tool".

ICE will strongly insist that there is no container present.

FEASIBILITY ISSUES:
The presence of a 20mX 2.5m "machine tool" is extremely unusual and will arouse inspector suspicion.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→(?) N18→N20→N22→G→END

CATEGORY OF START AMBIGUITY:
- [x] Production Limit On Mobile ICBMs Exceeded
- [ ] Undeclared New Variant Or Version
- [ ] Increase In Throw-weight
- [ ] Increase In Warhead Loading
- [ ] Other______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
[x] High [ ] Medium [ ] Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
[x] Emerging Democracy [ ] Chaos [ ] Oligarchy [x] Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

ITSIP has been provided with a database which predicts the maximum sizes of non-TLI objects expected to be shipped from the plant; the database has been updated based on visual observations and measurements taken by monitors. ITSIP recognizes that shipment of an item this large is quite exceptional; it suggests that the monitor request permission to weigh and X-ray the vehicle. ITSIP can also suggest to the inspector that he declare the "machine tool" to be a container which is subject to inspection by interior viewing or X-ray.

FEASIBILITY ISSUES: Establishment of the a priori database may be difficult; detection may be foiled by initially shipping a "machine tool" which does not contain an ICM and allowing extensive inspection.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? [ ] Yes [ ] No [x] Possibly

DETECTION METHODS

TOSI	NEW/SIMULATED
[x] X-ray	[x] A.I.
[x] Weight	[ ] NTM
[x] Size Measurement	[x] Other Shipment Data Base
[x] Visual Observation	[ ] Other ______
[ ] Other ______	[ ] Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? [ ] Yes [x] No

TREATY APPLICABILITY:
[ ] CWC/CW [ ] Open Skies [x] NPT
[x] START Follow-on [ ] CFE [ ] Other ______

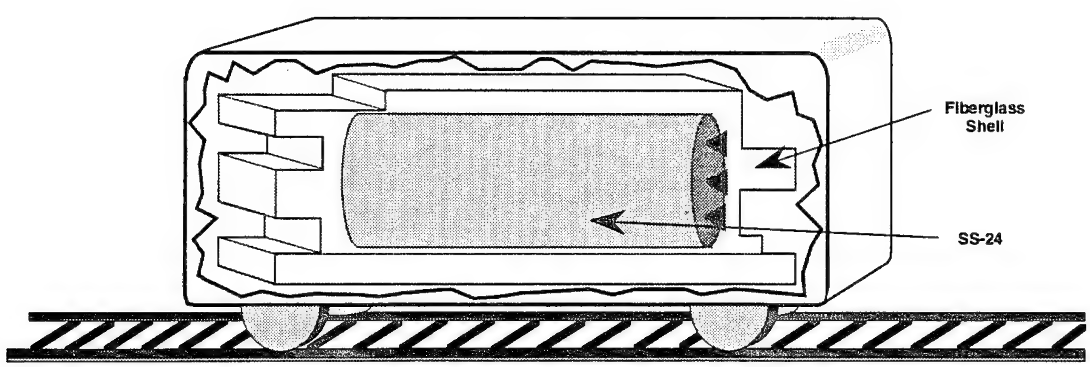


Figure A-22. Circumvention scenario no. 20: shell tool.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

94-0464.47

CIRCUMVENTION SCENARIO (CS) NO. 21 **NICKNAME:** False Edges

RANK: 4
TOTAL SCORE: 7.16
CS SCORE: 2.42
ITSIP VALUE: 3.00
TOSI VALUE: 1.73

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The ICE claims that a new variant of the SS-25, intended for space use, will be produced and is exempt from START ceilings. The "SS-25 variant" is distinguishable from the SS-25 ICBM since its diameter is 10% greater.

An unmodified, assembled SS-25 in a launch canister is placed in a rail car. A special lead plate fashioned to mask the true SS-25 casing edge and present another edge, is placed on the side of the SS-25 where the X-ray source will be. The entire shipment is concealed in a large wooden crate. The ICE elects non-damaging imaging of the container.

FEASIBILITY ISSUES: Designing this circumvention to be robust over variations in X-ray positioning geometries will be difficult.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
■ High □ Medium □ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
◪ Emerging Democracy □ Chaos
□ Oligarchy ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:
Close analysis of the X-ray trace reveals some unusual trends. There is a slow build-up to the normal peak value of the spike due to the masking lead plate and then a broader propellant curve. ITSIP reads the diameter indicated by the two "spikes"; and then invokes a simulation function which reads the calculated diameter and draws the simulated curve. The simulated curve may differ from the measured curve enough to cause ITSIP to indicate a substantial probability of violation.

FEASIBILITY ISSUES: If the special lead plates are made with a high degree of accuracy it may not be possible to observe any difference in the trace.

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
□ Weight	□ NTM
□ Size Measurement	■ Other Strain Gauge
■ Visual Observation	□ Other ______
□ Other ______	□ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ■ Yes □ No

TREATY APPLICABILITY:
□ CWC/CW □ Open Skies ■ NPT
■ START Follow-on □ CFE □ Other ______

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

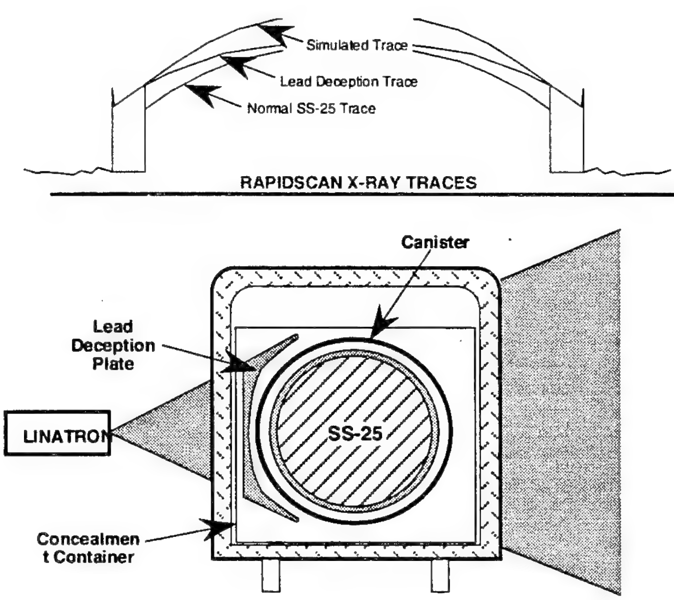


Figure A-23. Circumvention scenario no. 21: false edges.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.49

CIRCUMVENTION SCENARIO (CS) NO. 23 **NICKNAME:** Two for One

RANK:	15
TOTAL SCORE:	Not Calculated
CS SCORE:	Not Calculated
ITSIP VALUE:	Not Calculated
TOSI VALUE:	Not Calulated

CIRCUMVENTION TECHNIQUE DESCRIPTION:

Limited production of SS-25 missiles is continuing at a site subject to continuous monitoring. In order to exceed the Treaty-allowable number of ICBMs fielded, two first stage SRM's are shipped through the portal in one SS-25 missile launch canister, with the ICE declaring that each launch canister contains one complete missile. The upper stages are shipped out by road in containers too small to contain an ICM (and therefore not subject to inspection), and are mated to the first stages at a covert site. One such complete missile is fielded in a treaty compliant manner and the other goes into covert storage. This allows a doubling of the SS-25 force.

FEASIBILITY ISSUES:
Requires off-site mating of missile stages.

INSPECTION PROTOCOL SEQUENCE:
P1→P2→H→Y1→Y3→Y5→Y8→END.

DETECTION TECHNIQUE DESCRIPTION:
Circumvention cannot be detected at the portal under the inspection sequence noted above unless the inspector's suspicion is somehow aroused (perhaps by trend analysis) and he requests and is granted the ability to weigh the shipment (a launch canister containing two first stages should be approximately 125% of the expected weight.) An X-ray scan is likely not to be conclusive unless scans taken towards both ends of the canister suggest the presence of two first stages.

FEASIBILITY ISSUES:
It will be difficult to identify an increase in the rate of production through traffic analysis alone. Present procedures preclude detection unless the ICE cooperates.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ■ Yes □ No □ Possibly

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- □ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
□ High ■ Medium □ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
□ Emerging Democracy □ Chaos
■ Oligarchy ■ Russian Dictatorship

DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
■ Weight	□ NTM
□ Size Measurement	□ Other ______
□ Visual Observation	□ Other ______
□ Other ______	□ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? □ Yes ■ No

TREATY APPLICABILITY:
□ CWC/CW □ Open Skies □ NPT
■ START Follow-on □ CFE □ Other ______

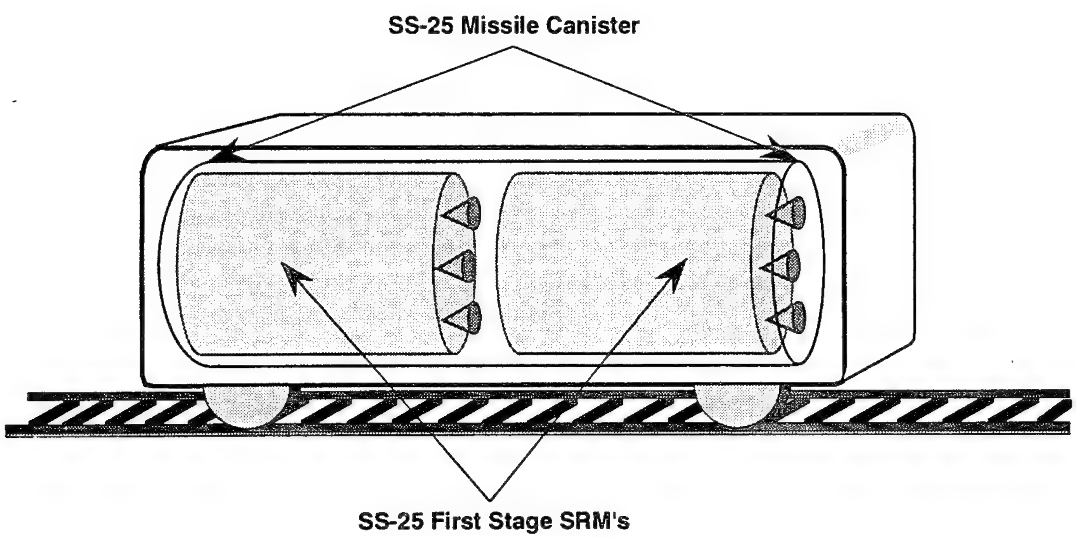


Figure A-24. Circumvention scenario no. 22: two for one.

APPENDIX B

ITSIP PROOF-OF-PRINCIPLE DEMONSTRATION PLAN

APPENDIX B

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX B

SECTION 1

INTRODUCTION

1.1 GENERAL.

This Appendix presents the requirements, responsibilities and methodology adopted to demonstrate the effectiveness of the Innovative Treaty Sensor Integration Project (ITSIP). The five (5) different distinct demonstrations conducted were: 1) offset variant plus; 2) concealed access; 3) false shell; 4) deaden; and 5) non-circumvention. For each of these individual demonstrations the object, measure of effectiveness (MOE), support requirements, site preparation and event sequence is described for the scenarios. An overview of the MOE is presented in Table B-1, Project measure of effectiveness (MOE) overview.

Table B-1. Project measure of effectiveness (MOE) overview.

General ITSIP Capability	Specific ITSIP Capability	Where Demonstrated
Discover Modernized Or Altered ICM When It Is Undeclared	Detect Changes in ICM Diameter	Phase 2 of Offset Variant Plus
Sensor Integration For Treaty Verification	Use Of X-ray Sensor Measurements and Monitor Observations To Eliminate or Confirm Possible ICMs and CSs	Phase 2 of Offset Variant Plus, False Shell, Deaden, and Non-Circumvention
A.I. For Treaty Verification	User-Friendly IP Tracking	Phase 2 of Offset Variant Plus, Concealed Access, False Shell, Deaden, and Non-Circumvention
A.I. For Treaty Verification	CS "Anticipation"	Phase 2 of Offset Variant Plus, Concealed Access, False Shell, and Deaden
Discover ICM When It Is Undeclared	Alert Monitor To Unusual Sensor Measurement	Phase 2 of False Shell and Deaden
Discover ICM When It Is Undeclared	Compare Measurements With ICM Physical Parameters	Phase 2 of Concealed Access and False Shell
Discover ICM When It Is Undeclared	Alert Monitor To Suspicious IP Sequence	Phase 2 of Concealed Access
Discover ICM When It Is Undeclared	Discover Scale Similarities In X-ray Images	Phase 2 of Offset Variant Plus

SECTION 2

PERSONNEL REQUIREMENTS

2.1 DEMONSTRATION DIRECTOR.

Orchestrates conduct of demonstration and serves as umpire. Rules as required on questions regarding demonstration preparation, conduct, and other issues that may arise. To be provided by TASC.

2.2 MONITOR.

Individual knowledgeable of START portal monitoring environment and inspection protocol. Plays the role of United States START Treaty portal monitor at a production facility for mobile ICBMs. Two or more to be provided by DNA.

2.3 ITSIP OPERATOR.

Individual knowledgeable of the ITSIP system. Operates ITSIP in support of the monitor. One or more to be provided by TASC.

2.4 RAPIDSCAN OPERATOR.

Individual capable of operating the X-ray equipment and associated computer system at TOSI. Examines X-ray traces and indicates his conclusions regarding the items X-rayed to the monitor, based only on X-ray data provided by RAPIDSCAN. Two experienced RAPIDSCAN operators to be provided by Raytheon or ARACOR.

2.5 IN-COUNTRY ESCORT (ICE).

Individual knowledgeable of START Treaty portal monitoring environment and inspection protocol. Portrays representative of host country seeking to secure exit of cargo from a production facility for mobile ICBMs. To be provided by TASC.

2.6 SUPPORT PERSONNEL.

To set up and break down demonstration support equipment for each phase of the demonstration. To be provided by Raytheon. The support personnel should be different individuals from the RAPIDSCAN operators.

2.7 OBSERVER(S).

Individuals to observe conduct of demonstration. To be provided by DNA.

SECTION 3

EQUIPMENT AND FACILITY REQUIREMENTS

3.1 The following items of hardware, software, and personnel support are required to support the demonstration and shall be provided by the TACT site operator:

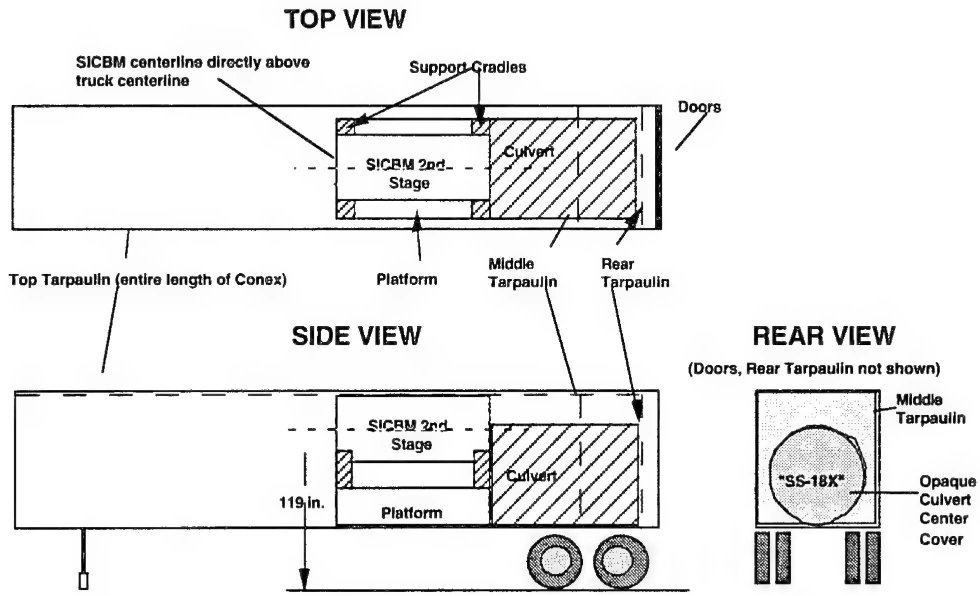
Table B-2. TACT hardware, software, and personnel support.

No.	Item	Demo 1	Demo 2	Demo 3	Demo 4	Demo 5	Notes
1	SICBM 2nd Stage	X		X			
2	SICBM Holding Fixture/Platform	X		X			See Figure B-1
3	Simulated SICBM canister shell						(Requirement deleted)
4	Test Articles 4A,4B		X		X		
5	Holding Bracket for 4A and 4B		X		X		See Figure B-2 for configuration
6	Flatbed Trailer with Conex Enclosure	X		X			
7	Railcar		X		X	X	
8	Overhead Projector	X	X	X	X	X	Set up in Radiography Lab
9	Projection Screen	X	X	X	X	X	Set up in Radiography Lab
10	Top Concealment Tarpaulin for Conex	X		X			See Figure B-1
11	Middle Concealment Tarpaulin for Conex	X		X			See Figure B-1
12	Rear Concealment Tarpaulin for Conex	X		X			See Figure B-1
13	Stepladder or functional equivalent	X		X			As required to allow monitor(s) to view inside the top of the Conex
14	Culvert Section (72" Dia, 9' Length)			X			See Figure B-1
15	Center cover for culvert section			X			Plywood or opaque canvas or vinyl material (see Figure B-1)
16	Concealment Tarpaulin for Railcar		X		X	X	See Figure B-2
17	Apple Image Writer II Printer	X	X	X	X	X	TASC will provide data cables; Raytheon to provide power cord
18	Desk Lamp(s) for Radiography Lab	X	X	X	X	X	As required to operate radiography equipment without ceiling lights
19	Radiography Equipment	X		X	X	X	All equipment needed to generate an X-ray scan

Table B-2. TACT hardware, software, and personnel support (Continued).

No.	Item	Demo 1	Demo 2	Demo 3	Demo 4	Demo 5	Notes
20	Macintosh System 7 Operating System or suitable file sharing software (e.g., TOPS)	X		X	X	X	Required for file transfer (TASC will provide cables)
21	Radiography Operators (2)	X		X	X	X	
22	Tractor and Driver to move flatbed trailer	X		X			
23	Support Personnel (2)	X	X	X	X	X	
24	8', 10', or 12' Tape Measure			X			Diameter of culvert section is to be measured
25	Spare Tarpaulins						Approximately 20% of specified quantity of tarpaulins
26	Cardboard Placard Labeled "SS-25"		X		X		Stenciled letters at least 4" high
27	Cardboard Placard Labeled "SS-18X"						(Requirement deleted)
28	Cardboard Placard Labeled "SHIPPING CRATE"	X	X		X	X	Stenciled letters at least 4" high (2 required)
29	Cardboard Placard Labeled "LAUNCH CANISTER"			X			Stenciled letters at least 4" high (2 required)
30	Cardboard Placard Labeled "NO ICBM PRESENT"					X	Stenciled letters at least 4" high

3.2 TACT facilities will be required for a maximum of five days – one day of set-up and a maximum of four demonstration days – during the demonstration period. This includes the use of the conference room.



Notes:
1. Scale is approximate.
2. Dimensions of support cradles are not critical.
3. Culvert rear end should be positioned no more than two feet from end of Conex.
4. Design of platform is not critical; however, a two foot minimum vertical gap between bottom of SICBM second stage and top of platform at center vertical section of stage, as shown, is required to allow a clear X-ray scan.

Figure B-1. Flatbed with CONEX configured with culvert section and SICBM second stage.

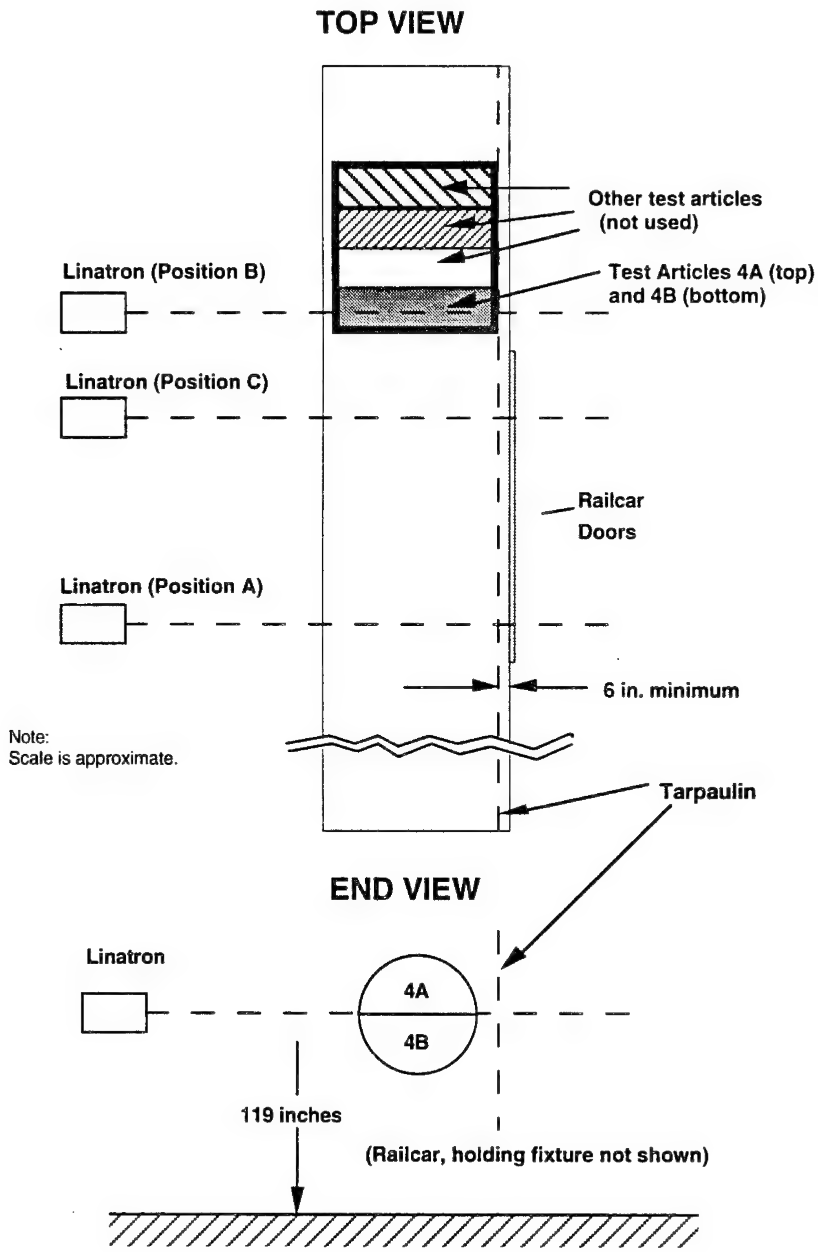


Figure B-2. Test articles 4A and 4B positioned in railcar.

SECTION 4

RESPONSIBILITIES

4.1 TASC.

- Prepare a pre-demonstration orientation for the individuals playing the role of the monitors that acquaints them to the extent required with the START Treaty and its portal monitoring provisions, the objectives and general procedures of the demonstration, and the role they will play in it.

- Provide the ITSIP system and connect ITSIP to the existing Macintosh computer on-site at TOSI.

- Provide Demonstration Director, ITSIP operator, and individual to act as In-Country Escort (ICE).

- Assemble and document demonstration results; write Demonstration Report.

4.2 RAYTHEON.

- Obtain equipment necessary to support the demonstration as specified in Section 3.

- Conduct physical set-up for each demonstration as described (paragraphs 5.1.5, 5.2.5, 5.3.5, 5.4.5, and 5.5.5 of this Demonstration Plan.)

- Provide two qualified RAPIDSCAN operators.

- Provide documentation to TASC of any hardware or software changes impacting the format of the X-ray scan file or impacting the nature of the received X-ray signal.

- Provide radiography safety briefing before the demonstration, as appropriate, to all participants and visitors.

4.3 DNA.

- Provide two personnel to serve as Treaty monitors during the Demonstration.

- Provide Observers as desired.

SECTION 5

CONDUCT OF THE DEMONSTRATION

5.1 GENERAL CONSIDERATIONS.

5.1.1 Sequence of Events.

There are five separate demonstrations described in this Demonstration Plan to be conducted at TOSI during the demonstration period. The sequence of events during the demonstration week will be as follows:

Day 1 (Monday):	Final set-up and preparation
Day 2 (Tuesday):	Orientation and safety briefing of participants
	Demonstration 2 (Concealed Access)
	Demonstration 5 (Non-Circumvention)
	Demonstration 4 (Deaden)
Day 3 (Wednesday):	Demonstration 1 (Offset Variant Plus)
	Demonstration 3 (False Shell)
	Monitor Debrief
Day 4 (Thursday):	Make up time for weather, etc.
	Break down equipment and depart TOSI site

The demonstrations are discussed separately in the following sections of this demonstration plan. This has been done for the sake of clarity and so that these demonstrations can be clearly linked to the previous data developed in this project. (For the TSAM Circumvention Scenarios, see Appendix A.)

5.1.2 Actions Necessary to Achieve Demonstration Objectives.

While every effort will be made within the constraints of available facilities and equipment to provide for demonstration realism, the need to conduct this demonstration within reasonable cost limits will require the use of some notional or simulated equipment, measurements and procedures. For example, the SICBM second stage will be used to simulate an SS-24, and "notional" dimensions consistent with demonstration equipment and procedures will be used in the ITSIP database for ICMs. In other cases, items may be marked with or assigned dimensions

that are not actual but do reflect the dimensions or weights of conveyances in the postulated situation. The use of these notional figures will simulate the real situation that could be expected at a portal monitoring location and will not detract from the validity of the demonstration. The use of notional items is indicated in Table B-3. In addition, label placards will be used in certain instances in the demonstrations when it is necessary to denote simulated items. These placards will always indicate "ground truth" rather than part of an attempted circumvention.

Table B-3. Notional items represented by actual items.

DEMONSTRATIONS	ACTUAL ITEM	NOTIONAL ITEM
All	SICBM 2nd Stage	SS-24 with simulated "test dimensions": Overall Length: 11 m, Diameter (1st stage): 1.17 m, Overall Weight: 105 MT
1	Rear Tarpaulin and Top Tarpaulin in Trailer (Figure B-1)	Large Shipping Crate, 38' x 7' x 7' (11.6 m x 2.13 m x 2.13 m)
3	Rear Tarpaulin and Top Tarpaulin in Trailer (Figure B-1)	"SS-18X" Missile Launch Canister, Diameter: 2.2 m
2, 4, 5	Concealment Tarpaulin in Railcar (Figure B-2)	Large Shipping Crate, 45' x 7' x 7' (13.7 m x 2.13 m x 2.13 m)
2, 4, 5	Test Articles 4A and 4B	SS-25 with simulated "test dimensions": Overall Length: 13 m; 1st Stage Diameter: 1.8 m; Overall Weight: 45 MT.
3	Culvert Section with center "plug" (Figure B-1)	Rear end of "SS-18X", Diameter: 2.0 m
4	Lead Plates over Linatron Detectors	Lead X-ray Attenuation Shield in Railcar
2	Doors 15.5 feet wide	Doors 1.0 m wide
4,5	Doors 15.5 feet wide	Doors entire length of railcar
2	Railcar Gross Weight	96 metric tons
4	Railcar Gross Weight	184 metric tons
2, 4	Railcar Tare Weight	50 metric tons

5.1.2.1 While the monitor (or monitors) should be familiar with general START treaty procedures and the protocol for portal inspections, *they will not be given this document or its annexes that contain the TSAM CSs*. Nor will they be given any details regarding the particular circumvention attempt that is underway (or whether it may be a circumvention attempt), as a treaty monitor stationed at a START portal will not have any *a priori* information of a circumvention attempt. Similarly, *the RAPIDSCAN operators, whose advice may be sought by the monitors, will not have access to this information.* However, the close involvement of those personnel qualified to be RAPIDSCAN operators with test items available at TOSI and the preparation of the X-ray system for this demonstration will reveal some information regarding possible scenarios to them. The RAPIDSCAN operators will be permitted to assist the monitor in evaluating the X-ray traces. However, any judgments made regarding the contents of the items X-rayed should be deduced from the X-ray trace, and previously obtained X-ray traces, rather than knowledge of test hardware in stock at TOSI or of pre-demonstration procedures.

5.1.2.2 The ITSIP operator will be aware of the circumvention attempt in progress due to his detailed involvement in development of the system, but will provide assistance to the monitor only with regard to the indications which ITSIP may provide for the use of the monitor, the other features of the system, and their use. In accordance with realistic circumstances, the individual playing the role of In-Country Escort (ICE) will know about the details of the circumvention to be attempted. The observers, who will have copies of this plan, should not offer any assistance or advice to the monitors. Finally, the Demonstration Director will adjudicate questions of notional measurements and definitions, referring to a copy of this Plan as necessary, and may prompt the other participants of the demonstration if necessary to continue progress of the demonstration. He may also rule on issues that arise between the In-Country Escort and the monitor.

5.1.2.3 For purposes of demonstrating ITSIP in a realistic environment, it is important that, for each scenario, ITSIP is not given any *a priori* information on which CS is being demonstrated. This reflects the operational situation at a portal.

5.1.2.4 It is important that the monitors not be able to anticipate the nature of upcoming demonstrations. At the end of each demonstration, the monitors will be told that they must leave the immediate demonstration area in order for the next demonstration to be set up. Even if no reconfiguration of the demonstration items is necessary, personnel and moving equipment (such as a fork lift) should be visibly present at the end of each demonstration. The demonstration platform (railcar or flatbed trailer) should be rolled out of the demonstration location at the end of each demonstration. A non-circumvention demonstration will be conducted on Day 1 to lessen the likelihood that the monitors will assume that circumvention is occurring in every case.

5.1.2.5 Assuming that two monitors are available to support the demonstration, *different monitors should conduct the baseline inspection and the proof-of-principle inspection for each scenario*. The monitor who will conduct the proof-of-principle inspection should not observe the baseline inspection. The monitor who conducts the baseline inspection may be present for the proof-of-principle inspection but cannot influence its conduct in any way. The monitors should be rotated so that each will have an opportunity to conduct both baseline inspections and proof-of-principle inspections, although for different scenarios, in order to obtain assessments from both monitors on the utility of ITSIP. The actual scenario "in play" will not be revealed to the Phase 1 monitor after Phase 1, nor will it be revealed to the Phase 2 monitor after Phase 2. Instead, the actions taken by each monitor will be recorded for later evaluation. After completion of all five demonstrations, both monitors will be debriefed and the detailed set-up of each demonstration will be revealed to them.

5.1.2.6 If the same individual performs as the RAPIDSCAN Operator in Phases 1 and 2 of the demonstration, *the advice presented to the monitor in Phase 2 will be required to be precisely the same advice given to the Phase 1 monitor.* This is consistent with the fact that the demonstration set-up has not changed; thus, the RAPIDSCAN Operator will not be able to take advantage of facts made obvious after collection of the X-ray image in Phase 1 of the demonstration.

5.1.2.7 As an element of the post-demonstration assessment, this document will be made available to the monitors after completion of the demonstration and their viewpoints will be solicited with regard to the demonstration procedure, the perceived value of ITSIP in portal monitoring and in other arms control treaty verification regimes, and suggested enhancements to the system.

5.2 DEMONSTRATION NUMBER ONE: OFFSET VARIANT PLUS.

5.2.1 Introduction.

The Circumvention Scenario is described in detail in the Offset Variant Plus TSAM CS (Scenario #8a, Appendix A). In brief, the ICE is trying to pass off a treaty-limited SS-24 (simulated by a SICBM) as a smaller, tactical missile which is not limited by the START Treaty by offsetting it laterally in the railcar so that it presents a different X-ray profile.

5.2.2 ITSIP Objective.

ITSIP will identify the type of an ICM or ICMs which may be present and the corresponding position offset based on its processing of the X-ray scan and comparison with stored signatures. It will also identify CSs which may be underway based on the inspection sequence and measurements.

5.2.3 Measure of Effectiveness For This Demonstration.

ITSIP should declare that the railcar may contain an SS-24 (represented by the SICBM second stage.) The actual ICM type and the position offset relative to the center of the rail-bed (within 10" accuracy) shall be indicated by ITSIP, and ITSIP shall declare that the Offset Variant Plus CS is likely to be underway.

5.2.4 Required Equipment.

Item	Notes
SICBM 2nd Stage	
SICBM Holding Fixture/Platform	See Figure B-1
Flatbed Trailer with Conex Enclosure	
Overhead Projector	Set up in Radiography Lab
Projection Screen	Set up in Radiography Lab
Top Concealment Tarpaulin for Conex	See Figure B-1
Middle Concealment Tarpaulin for Conex	See Figure B-1
Rear Concealment Tarpaulin for Conex	See Figure B-1
Stepladder or functional equivalent	As required to allow monitor(s) to view inside the top of the Conex
Apple Image Writer II Printer	TASC will provide data cables; Raytheon to provide power cord
Desk Lamp(s) for Radiography Lab	As required to operate radiography equipment without ceiling lights
Radiography Equipment	All equipment needed to generate an X-ray scan
Macintosh System 7 Operating System or suitable file sharing software (e.g., TOPS)	Required for file transfer (TASC will provide cables)
Tractor and Driver to move flatbed trailer	
Cardboard Placard Labeled "SHIPPING CRATE"	Stenciled letters at least 4" high (2 required)

5.2.5 Site Preparation and Demonstration Set-Up.

Advance Preparation:

- Configure the SICBM second stage, the culvert section, and the concealment tarpaulins in the flatbed trailer as shown in Figure B-1.
- Position the trailer with its longitudinal centerline directly above the center of the rails, and its longitudinal position such that the center of the SICBM second stage is aligned with the Linatron fan beam (position A of Figure B-3.)
- Obtain and store an X-ray scan at 9 MeV over the full 30 degree detector range.

Pre-Demonstration Preparation:

- Disable or switch off any TV monitors allowing viewing of flatbed trailer from inside Radiography area.
- Position the trailer with its longitudinal centerline 30 inches North of the center of the rails (offset away from the Linatron with respect to the railbed centerline) and its longitudinal position such that the center of the SICBM second stage is aligned with the Linatron fan beam (position B of Figure B-3.)
- Place one label placard marked "SHIPPING CRATE" on top of the top tarpaulin in the trailer, so that the labeling is visible from above. Place another label placard marked "SHIPPING CRATE" in the rear of the trailer,

between the rear tarpaulin and the rear doors, so that the lettering is visible from outside the trailer. If necessary this placard may be secured with tacks or tape.

- Close the rear doors of the trailer.
- Prepare the RAPIDSCAN computer to transfer files to ITSIP with the TOPS software by mounting the folder named "DEMO SCANS" from ITSIP after it is published by the ITSIP operator.

In-Demonstration Support:

- Open the rear doors of the trailer.
- Obtain an X-ray scan at 9 MeV over the full 30 degree detector range.

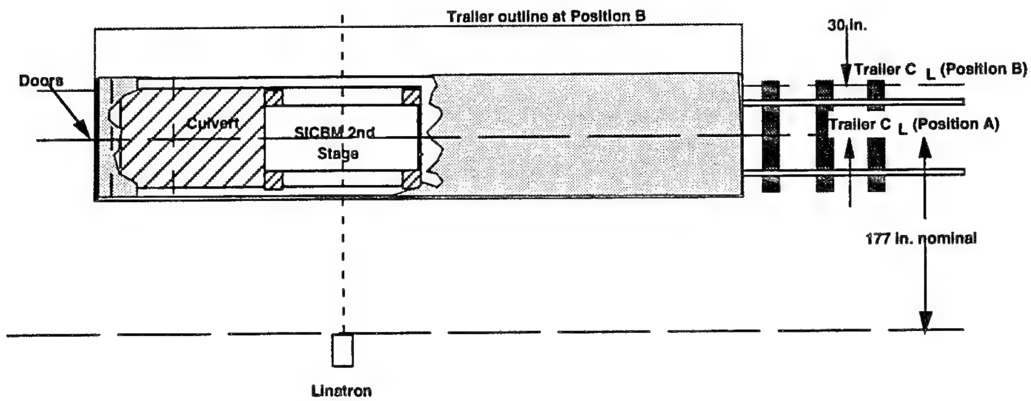


Figure B-3. Trailer position in radiography area (top view).

5.2.6 Personnel Support.

One (1) RAPIDSCAN Operator, two (2) Support Personnel, two (2) Monitors, one (1) ITSIP Operator, and one (1) In-Country Escort (ICE).

5.2.7 Estimated Demonstration Duration.

Two hours.

5.2.8 Demonstration Event Sequence.

5.2.8.1 Phase 1: Baseline Performance.

The monitors perform the inspection without ITSIP.

- **1** ***ICE.*** Declares that a new tactical missile is present – smaller than an SS-25 and not constrained by the START Treaty – which is not an ICM. Opts to allow viewing of the interior of the vehicle per paragraph 9(d) of the "START Inspection Protocol Procedures for Continuous Monitoring" (IP).

- **2** ***Monitor.*** Consults the written START IP to determine whether he has any other alternatives. Accompanies the ICE outside into the Radiography bay to view the interior of the vehicle from the rear doors.

- **3** ***ICE.*** Requests that the doors of the vehicle be opened.

- **4** ***Support Personnel.*** They open the rear doors of the vehicle.

- **5** ***Monitor.*** Declares that he cannot verify the absence of an ICM, since a container (the tarpaulin represents a large shipping crate as indicated in Table B-3) is present which appears to be large enough to contain an ICM. This leads through the inspection protocol to verification that the container does not contain an ICM.

- **6** ***ICE.*** Does not allow measurement of the container. Nor does he allow viewing of the interior of the container. Declines to remove the contents of the container for viewing. *(Thus the ICE is obligated by the IP to allow non-destructive imaging of the contents.)*

- **7** ***Monitor.*** Again consults the START IP. Instructs RAPIDSCAN operators to image the contents of the "container" as it stands within the vehicle. This will be the last procedure allowed in the inspection.

- **8** ***RAPIDSCAN Operator.*** Operates the RAPIDSCAN equipment as required to X-ray the contents of the "container." Displays the resulting image for viewing by the monitor. *The missile offset from centerline parameter will not be available to the operator;* the operator may be advised that the scenario is consistent with a railcar with contents obscured from view. The operator will advise the monitor of any conclusions which can be made from the scan. Most likely, the operator will indicate that the results of the scan are indeterminate: it appears to reveal a missile, but the actual diameter cannot be calculated without knowing the offset.

- **9** ***Monitor.*** Makes a decision regarding whether the image indicates an ambiguity or not. If he believes that an ambiguity is indicated, he must indicate the type of circumvention suspected and record his decision accordingly, including his rationale for the decision. Files of past X-ray scans will be made available for his viewing by the RAPIDSCAN operators.

5.2.8.2 Phase 2: Proof-of-Principle.

The "inspection" is repeated with the help of ITSIP. Steps 1-7 of the inspection above are repeated with the exception that the monitor tracks his progress through the inspection protocol by clicking on the appropriate path on the ITSIP representation of the Inspection Protocol Flowchart. (ITSIP operators will provide "help" to the monitor in tracking the flowchart in ITSIP.) The path taken is P1...P3...I...N1...N3...N5...N16...N17...D...C1...C3...C5.

- 1 ***RAPIDSCAN Operators***. Operate the RAPIDSCAN equipment as required to X-ray the contents of the "container." Save the X-ray scan files in the ITSIP "DEMO SCANS" folder mounted on RAPIDSCAN.
- 2 ***ITSIP Operator***. Selects the "Load Present Scan" button, selects the appropriate X-ray scan file names, and then starts the X-ray matching function on ITSIP.
- 3 ***ITSIP***. Processes the file by comparing the scanned data to each ICM signature in its reference set, including scaling factors. It finds that the scan looks like that of an SS-24 shifted by about 30 inches laterally. ITSIP indicates a match with the suspected ICM type and the calculated offset. This is a clear indication of an ambiguity and ITSIP displays an appropriate warning for the monitor.

5.2.8.3 End of Demonstration.

5.3 DEMONSTRATION NUMBER TWO: CONCEALED ACCESS.

5.3.1 Introduction.

The Circumvention Scenario is described in detail in the "Concealed Access" TSAM CS (Scenario #3, Appendix A). In brief, the in-country escort is trying to conclude a portal inspection of a railcar containing an SS-25 by steering the inspection procedure towards measurement of access doors, which are too small to admit an ICM. (The ICM has been inserted by removing the roof of the railcar inside the factory and then re-installing it.)

5.3.2 ITSIP Objective.

ITSIP should alert the treaty monitor to a "Concealed Access" circumvention attempt based on the knowledge that the "measurement of access doors" is being performed and is the basis for demonstrating the absence of ICMs. ITSIP should support the decision-making of the monitor by illustrating his progress through the Inspection Protocol and his available options, retrieve relevant data on ICM and TLI physical characteristics, and use it to make conclusions based on measured and observed characteristics.

5.3.3 Measure of Effectiveness For This Demonstration.

ITSIP should alert the treaty monitor to a "Concealed Access" circumvention attempt based on the knowledge that the "measurement of access doors" is being performed and is the basis for demonstrating the absence of ICMs. ITSIP should correctly exclude the SS-24 based on the weight measurement. It should identify all ICMs that can fit within the dimensions of spaces which are input. This applies to the obscured space in the railcar and to the space within the measured "container." ITSIP should also advise the monitor to declare the possible existence of, and search carefully for, alternate accesses and, if found, to use those measurements as the criteria for access to the railcar.

5.3.4 Required Equipment.

Item	Notes
Test Articles 4A,4B	
Holding Bracket for 4A and 4B	See Figure B-2 for configuration
Railcar	
Overhead Projector	Set up in Radiography Lab
Projection Screen	Set up in Radiography Lab
Concealment Tarpaulin for Railcar	See Figure B-2
Apple Image Writer II Printer	TASC will provide data cables; Raytheon to provide power cord
Desk Lamp(s) for Radiography Lab	As required to operate radiography equipment without ceiling lights
Cardboard Placard Labeled "SS-25"	Stenciled letters at least 4" high
Cardboard Placard Labeled "SHIPPING CRATE"	Stenciled letters at least 4" high

5.3.5 Site Preparation and Demonstration Set-Up.

Advance Preparation:

- Configure test articles 4A and 4B and the concealment tarpaulin in the railcar as shown in Figure B-2.

Pre-Demonstration Preparation:

- Disable or switch off TV monitors allowing viewing of railcar from the top or far side of radiography area.
- Position the railcar within the Radiography area with the doors facing North (away from the Linatron.) Longitudinal position of the railcar is not critical.
- Place the label placard marked "SS-25" next to test articles 4A and 4B so that the lettering would be visible to an observer outside the open doors of the railcar if the tarpaulin were not in place. This placard may be secured to the test articles or holding stand if required. Place one of the label placards marked "SHIPPING CRATE" between the tarpaulin and the doors of the

railcar, securing it to the tarpaulin if necessary to hold it in place, so that it is readable to an observer standing outside the open doors of the railcar.

- Close the doors of the railcar.

<u>In-Demonstration Support:</u>

- Open the doors of the railcar.

- Slide aside the tarpaulin to permit viewing of articles 4A and 4B from outside of the open doors of the railcar.

5.3.6 Personnel Support.

Two (2) Support Personnel, two (2) Monitors, one (1) ITSIP Operator, and one In-Country Escort (ICE).

5.3.7 Estimated Demonstration Duration.

Two hours.

5.3.8 Demonstration Event Sequence.

5.3.8.1 Phase 1: Baseline Performance.

The monitors perform the inspection without ITSIP.

- **1** ***ICE***. Declares that the railcar contains no ICMs; indicates that he will satisfy the IP requirements by allowing the "access measurement" of paragraph 9(a) of the "START Inspection Protocol Procedures for Continuous Monitoring" to be conducted.

- **2** ***Monitor***. Consults the written START Inspection Protocol to determine whether he has any alternatives. "Measures" the access doors designated by the ICE. (The Demonstration Director will provide the notional width of 1.0 meters IAW Table B-3.) Consulting the START ICM data, determines that the doors are apparently too small to admit an ICM. Again, he consults the written START IP.

- **3** ***ICE***. Wishes the treaty monitor "good day" and exits the portal facility. He signals the train (railcar) to go forward.

What has just been described is one way in which the baseline inspection could go. However, it is also possible that an experienced monitor would suspect a circumvention and argue for further inspection on the same grounds as for the proof-of-principle case. Since the presence or absence of ITSIP is transparent to the ICE, he should be prepared in this case to let the inspection proceed with the same latitude he allows the monitor in the proof-of-principle case,

providing his requests are well argued and in accordance with the provisions of the inspection protocol.

5.3.8.2 Phase 2: Proof-of-Principle.

The "inspection" is repeated with the help of ITSIP.

- **1 *ICE.*** Declares that the railcar contains no ICMs; indicates that he will satisfy the IP requirements by allowing the "access measurement" of paragraph 9(a) of the "START Inspection Protocol Procedures for Continuous Monitoring," to be conducted. Accordingly, opts for inspection procedure P1...P3...I...N2.

- **2 *Monitor*.** Tracks his progress through the inspection protocol by clicking on the appropriate path on the ITSIP representation of the Inspection Protocol Flowchart. (ITSIP operators will assist the monitor in tracking the flowchart in ITSIP.)

- **3 *ITSIP*.** Displays a dialog box for entry of the relevant measurements.

- **4 *Monitor*.** "Measures" the access doors designated by the ICE (the Demonstration Director will provide the notional width of 1.0 meters IAW Table B-3) and enters the results of the measurement into ITSIP.

- **5 *ITSIP*.** Indicates that the access doors measured are too small to admit any ICM, but warns the monitor that a "Concealed Access" CS is possible. A number of circumvention techniques which cannot be ruled out on the basis of the measurement are listed for potential monitor investigation. ITSIP suggests that the monitor declare that the roof of the rail-car is an access and that the railcar is subject to additional inspections.

- **6 *Monitor*.** Informs the ICE that other possible accesses to the railcar may exist, including, but not limited to, the roof of the railcar, and that therefore further inspection is required. Viewing the progress of the ITSIP flowchart, the monitor proposes viewing of the interior of the railcar per paragraph 9(d) of the "START Inspection Protocol for Continuous Monitoring."

At this point a disagreement regarding interpretation of the IP between the ICE and the monitor is likely. The ICE may claim that the monitor's statement is "frivolous", especially if the ICE is aware that a circumvention attempt is underway, and may refuse to allow further inspection, based on strict interpretation of the IP. In this case the ICE would wave the train (railcar) forward and the inspection would be over. On the other hand, perhaps the ICE will allow further inspection the first time, either because circumvention is not actually occurring (perhaps as part of the preprogramming that would undoubtedly occur for this CS) or because of error. Accordingly, the inspection proceeds.

- **7 *ICE*.** Again declines to allow the monitor to view the interior of the railcar. Instead, he elects to have the railcar weighed (N8...N11.)

- **8** ***Monitor***. Simulates weighing of the railcar by typing the "measured" weight into ITSIP as well as the railcar tare weight. The Demonstration Director, with reference to Table 3, provides a "measured" gross weight of 96 metric tons and a railcar tare weight of 50 metric tons.

- **9** ***ITSIP***. Checks its database on missile weights. On the basis of the measured weight it is able to rule out the SS-24 missile, but not the SS-25 missile. ITSIP displays a list of ICMs with weights equal to or less than the net railcar weight, along with a list of possible circumvention techniques not yet ruled out. The physical characteristics of remaining possible ICMs and information and illustrations for possible circumvention scenarios is available for optional monitor recall on ITSIP. ITSIP recommends that paragraph 9(d) of the "START Inspection Protocol for Continuous Monitoring," authorized by the IP, be exercised.

- **10** ***Monitor***. Informs the ICE that the weight test indicates that the railcar "is heavy enough to contain an ICM", and that viewing of the interior of the railcar will be required according to the IP (N13).

- **11** ***ICE***. Requests that the TOSI operators open the doors on the railcar.

- **12** ***Support Personnel.*** They open the doors of the railcar.

- **13** ***Monitor***. Views the interior of the railcar. He can see a large wooden "crate" which appears to extend nearly the entire length of the railcar. The dimensions of the "crate" exceed the dimensions of the access door; hence, the monitor may become suspicious.

- **14** ***ICE***. States that the "packing crate" contains photoelectric components produced in the factory which would be permanently damaged by X-ray imaging.

- **15** ***Monitor***. Enters the estimated dimensions of the "crate" into ITSIP. (The Demonstration Director provides the notional dimensions of the "shipping crate" with reference to Table B-3.)

- **16** ***ITSIP***. Consults its data base of missile dimensions and determines which known objects the measured obscured space can contain. ITSIP indicates that an SS-25 will fit in the remaining space. ITSIP highlights the flow through the IP which now leads to the point "D" (N16...N17) in the flowchart.

- **17** ***Monitor***. Informs the ICE that inspection of the "container" will be required.

- **18** ***ICE***. Elects to allow the monitor to measure the dimensions of the container (paragraph 10(a)) of the "START Inspection Protocol for Continuous Monitoring."

- **19** ***Monitor.*** Simulates measurement of the dimensions of the "container" in accordance with paragraph 10(a) of the "START Inspection Protocol for Continuous Monitoring," by entering the notional dimensions for the container provided by the Demonstration Director with reference to Table 3. Enters the results into ITSIP.

- **20** ***ITSIP***. Indicates that an SS-25 still cannot be excluded. Recommends viewing of the interior of the container (paragraph 10(b) of the "START Inspection Protocol for Continuous Monitoring," at C4.)

- **21** ***Monitor***. Requests that the ICE remove the "cover" of the "container" IAW paragraph 10(b) of the "START Inspection Protocol for Continuous Monitoring," at C4.

- **22** ***ICE***. Directs the TOSI operators to remove the "cover".

- **23** ***Support Personnel.*** They remove the tarpaulin.

- **24** ***All.*** They observe the obvious shape of an SS-25.

- **25** ***ICE***. Shakes his head in "disbelief." Insists that a "loading error" must have occurred.

5.3.8.3 End of Demonstration.

5.4 DEMONSTRATION NUMBER THREE: FALSE SHELL.

5.4.1 Introduction.

The Circumvention Scenario is described in TSAM CS #11 (Appendix A). The circumventors have concealed a ICM inside a shell which appears outwardly to be another missile. (This is akin to the INF "missile-in-a-missile" scenario).

5.4.2 ITSIP Objective.

To recognize the possibility that an ICM is concealed within the "SS-18X", to guide the monitors through the performance and interpretation of the inspection procedures, and to identify the concealed ICM.

5.4.3 Measure of Effectiveness For This Demonstration.

ITSIP should display the designations of all ICMs which would fit inside the measured items and provide their physical parameters for optional monitor recall. The entry of measured dimensions of a large canister into ITSIP should trigger a warning that the FALSE SHELL CS may be in use. When an X-ray scan is collected, ITSIP should identify the concealed ICM.

5.4.4 Required Equipment.

Item	Notes
SICBM 2nd Stage	
SICBM Holding Fixture/Platform	See Figure B-1
Flatbed Trailer with Conex Enclosure	
Overhead Projector	Set up in Radiography Lab
Projection Screen	Set up in Radiography Lab
Top Concealment Tarpaulin for Conex	See Figure B-1
Middle Concealment Tarpaulin for Conex	See Figure B-1
Rear Concealment Tarpaulin for Conex	See Figure B-1
Stepladder or functional equivalent	As required to allow monitor(s) to view inside the top of the Conex
Culvert Section (72" Dia, 9' Length)	See Figure B-1
Center cover for culvert section	Plywood or opaque canvas or vinyl material (see Figure 1)
Apple Image Writer II Printer	TASC will provide data cables; Raytheon to provide power cord
Desk Lamp(s) for Radiography Lab	As required to operate radiography equipment without ceiling lights
Radiography Equipment	All equipment needed to generate an X-ray scan
Macintosh System 7 Operating System or suitable file sharing software (e.g., TOPS)	Required for file transfer (TASC will provide cables)
Tractor and Driver to move flatbed trailer	
8', 10', or 12' Tape Measure	Diameter of culvert section is to be measured
Cardboard Placard Labeled "LAUNCH CANISTER"	Stenciled letters at least 4" high (2 required)

5.4.5 Site Preparation and Demonstration Set-Up.

Advance Preparation:

- Configure the SICBM second stage, the culvert section, and the concealment tarpaulins in the flatbed trailer as shown in Figure 1.

Pre-Demonstration Preparation:

- Disable or switch off TV monitors allowing viewing of flatbed trailer from top or far side of Radiography area.

- Position the trailer with its longitudinal centerline directly above the center of the rails, and its longitudinal position such that the center of the SICBM second stage is aligned with the Linatron fan beam (position A of Figure B-3.)

- Place one label placard marked "LAUNCH CANISTER" on top of the top tarpaulin in the trailer, so that the labeling is visible from above. Place another label placard marked "LAUNCH CANISTER" in the rear of the trailer, between the rear tarpaulin and the rear doors, so that the lettering is visible from outside the trailer. If necessary this placard may be secured with tacks or tape.

- Close the rear doors of the trailer.

- Prepare the RAPIDSCAN computer to transfer files to ITSIP with the TOPS software by mounting the folder named "DEMO SCANS" from ITSIP after it is published by the ITSIP operator.

<u>In-Demonstration Support:</u>

- Open the rear doors of the flatbed trailer.
- Slide or pull back the rear tarpaulin in the flatbed trailer to allow viewing of the end of the culvert section.
- Obtain an X-ray scan at 9 MeV over the full 30 degree detector range.

5.4.6 Personnel Support.

One (1) RAPIDSCAN Operator, two (2) Monitors, one (1) ITSIP Operator, one (1) In-Country Escort (ICE), and two (2) Support Personnel.

5.4.7 Estimated Demonstration Duration.

Two hours.

5.4.8 Demonstration Event Sequence.

5.4.8.1 Phase 1: Baseline Performance.

The monitors perform the inspection without ITSIP.

- **1** ***ICE.*** Declares that the vehicle does not contain an ICM, but does contain a modified "SS-18X" missile for space use. Invites the monitor to view the "SS-18X" missile within the vehicle to verify its identity and claims that the distinction between the SS-18X and any ICM will be obvious. Requests that the Support Personnel open the doors of the vehicle.
- **2** ***Support Personnel.*** They open the rear doors of the vehicle.
- **3** ***Monitor.*** Consults the START IP to determine what his alternatives are. Views the interior of the railcar and sees the covered item which represents the "SS-18X" launch canister. Consults the IP again and requests that the ICE allow viewing of the interior of the "launch canister."
- **4** ***ICE.*** Agrees to remove one of the "end caps" of the canister.
- **5** ***Support Personnel.*** They pull the tarpaulin back from the rear of the trailer, exposing the entire end face of the culvert that simulates the "SS-18X" shell, but keeping the SICBM second stage (which represents an SS-24), concealed by the opaque culvert center cover.

- **6** ***ICE***. Directs the monitor to proceed to the end of the "SS-18X" at which the tarpaulin has been pulled back. This simulates the removal of the launch canister end cap.

- **7** ***Monitor***. "Measures" the diameter of the "SS-18X." (The Demonstration Director provides the diameter to be used with reference to Table B-3.) The monitor then consults data on the diameters of ICMs, referring to START Treaty Memoranda if desired. Finding that none have the diameter he has measured, he confirms that the "contents of the canister" are not a ICM; this ends the inspection.

5.4.8.2 Phase 2: Proof-of-Principle.

The "inspection" is repeated with the help of ITSIP. Steps 1-6 of Phase 1 are repeated with the exception that the monitor tracks his progress through the Inspection Protocol by clicking on the appropriate path of the ITSIP flowchart representation of the IP (with ITSIP operator assistance.) The IP path is P1...P3...I...N1...N3...N5...N16...N18...N19...E...L2.)

- **1** ***Monitor***. Views the culvert with end cover representing the "SS-18X," after the ICE removes the end of the canister containing it. He "measures" the diameter of the "SS-18X." (The Demonstration Director provides the diameter to be used with reference to Table B-3.) The monitor is unable to measure the length of the "SS-18X" so he estimates the length of the railcar, which is an upper bound on the length of the SS-18X. The monitor then enters the "measured" diameter and maximum length of the object within the canister into ITSIP.

- **2** ***ITSIP***. Checks these dimensions against the ICM database, in which no known ICMs have the measured diameter. It checks the dimensions to see whether any ICMs could fit within the item. Finding that an SS-24 could fit within an object of the size indicated, ITSIP retains the SS-24 as one of the remaining possible ICMs, recommends that the monitor *not confirm* that the launch canister does not contain an ICM, and indicates "False Shell" as a CS recommended for optional monitor review on the system. In this case, ITSIP shows, the inspection options include viewing the contents of the launch canister after they have been removed by the ICE (paragraph 11(b)) of the "START Inspection Protocol for Continuous Monitoring," or performing non-damaging imaging of the contents of the launch canister (paragraph 11(c)) of the "START Inspection Protocol for Continuous Monitoring."

- **3** ***Monitor.*** Declares that he *cannot confirm* that the canister does not contain a ICM, and will therefore require further inspection.

- **4** ***ICE***. Elects to allow the monitor to perform non-damaging imaging of the contents of the canister within the railcar.

- **5** ***Monitor***. Selects IP buttons L5...L3 on ITSIP (with the help of the ITSIP Operator.) Directs the RAPIDSCAN operators to X-ray the railcar and its contents.

- **6** ***RAPIDSCAN Operator***. X-rays the railcar and its contents. The X-ray scan taken is that of a cross-section of the SICBM second stage. Saves the X-ray scan files in the ITSIP "DEMO SCANS" folder mounted on RAPIDSCAN.

- **7** ***ITSIP Operator***. Selects the "Load Present Scan" button, selects the appropriate X-ray scan file names, and then starts the X-ray matching function on ITSIP.

- **8** ***ITSIP***. Examines the X-ray scan and determines that it is a very close match to that of an SS-24 (represented by the SICBM in this demonstration.)

- **9.** ***Monitor***. Declares an ambiguity based on the fact that the contents of the railcar produce an X-ray scan similar to that of an SS-24 ICM.

5.4.8.3 End of Demonstration.

5.5 DEMONSTRATION NUMBER FOUR: DEADEN.

5.5.1 Introduction.

The Circumvention Scenario is fully described in TSAM CS # 1 (Appendix A). The railcar contains a ICM and thick lead plates designed to absorb most of the X-ray beam. In brief, the ICE intends to fulfill the inspection requirements by allowing an X-ray scan of the railcar which will provide little or no information to the treaty monitor. In fact, he is concealing the presence of an SS-25 (simulated by test articles 4A and 4B.)

5.5.2 ITSIP Objective.

To recognize the lack of signal obtained in the X-ray scan as an indication of possible circumvention, and to provide the treaty monitor with alternatives to either confirm or discount this possibility. Also, to request and use weight data based on the findings reached with the X-ray data, to gain information about the contents of the railcar.

5.5.3 Measure of Effectiveness For This Demonstration.

ITSIP should recognize the "dead" X-ray file as an indication of excessive attenuation and should warn of the possibility that a "Deaden" CS is in use. It should recommend that the monitor perform the second X-ray scan. If the second X-ray scan is also a "dead" X-ray file, ITSIP should recommend that vehicle weighing be performed, and should use the weight data to confirm that the "Deaden" CS is likely. If the second scan produces a signature, ITSIP should identify the ICM type scanned.

5.5.4 Required Equipment.

Item	Notes
Test Articles 4A,4B	
Holding Bracket for 4A and 4B	See Figure B-2 for configuration
Railcar	
Overhead Projector	Set up in Radiography Lab
Projection Screen	Set up in Radiography Lab
Concealment Tarpaulin for Railcar	See Figure B-2
Apple Image Writer II Printer	TASC will provide data cables; Raytheon to provide power cord
Desk Lamp(s) for Radiography Lab	As required to operate radiography equipment without ceiling lights
Radiography Equipment	All equipment needed to generate an X-ray scan
Macintosh System 7 Operating System or suitable file sharing software (e.g., TOPS)	Required for file transfer (TASC will provide cables)
Cardboard Placard Labeled "SS-25"	Stenciled letters at least 4" high
Cardboard Placard Labeled "SHIPPING CRATE"	Stenciled letters at least 4" high

5.5.5 Site Preparation and Demonstration Set-Up.

Advance Preparation:

- Configure Test Articles 4A and 4B and the concealment tarpaulin in the railcar as shown in Figure B-2.

Pre-Demonstration Preparation:

- Disable or switch off TV monitors allowing viewing of railcar from top or far side of radiography area.

- Position the railcar within the radiography area with the doors facing North (away from the Linatron) and its longitudinal position such that the center of test articles 4A and 4B is approximately fifteen feet out of alignment with the Linatron fan beam, as shown in Figure B-2, position A.

- Place the label placard marked "SS-25" next to test articles 4A and 4B so that the lettering would be visible to an observer outside the open doors of the railcar if the tarpaulin were not in place. This placard may be secured to the test articles or holding stand if required. Place one of the label placards marked "SHIPPING CRATE" between the tarpaulin and the doors of the railcar, securing it to the tarpaulin if necessary to hold it in place, so that it is readable to an observer standing outside the open doors of the railcar.

- Close the doors of the railcar.

- Place lead plates over the X-ray detectors.

- Prepare the RAPIDSCAN computer to transfer files to ITSIP with the TOPS software by mounting the folder named "DEMO SCANS" from ITSIP after it is published by the ITSIP operator.

In-Demonstration Support:

- Obtain an X-ray scan at 9 MeV over the full 30 degree detector range.
- Move the railcar about ten feet down-track so that the Linatron fan beam is aligned as shown in Figure B-2, position C.
- Obtain a second X-ray scan at 9 MeV over the full 30 degree detector range.
- Move the railcar down-track so that the center of test articles 4A and 4B is aligned with the Linatron fan beam as shown in Figure B-2, position B.
- Remove the lead plates covering the X-ray detectors.
- Obtain a third X-ray scan at 9 MeV over the full 30 degree detector range with the lead plates removed.

5.5.6 Personnel Support.

One (1) RAPIDSCAN Operator, two (2) Monitors, one (1) ITSIP Operator, two (2) Support Personnel, and one (1) In-Country Escort (ICE.)

5.5.7 Estimated Demonstration Duration.

Two hours.

5.5.8 Demonstration Event Sequence.

5.5.8.1 Phase 1: Baseline Performance.

The monitors perform the inspection without ITSIP.

- **1** ***ICE***. Arrives at the portal with a railcar, and explains that the car has been laboriously packed with industrial equipment and indicates that he wishes to fulfill the inspection requirements by having an X-ray scan performed. The ICE designates a location outside the open doors of the railcar from which the monitor may view the interior of the railcar IAW paragraph 9(d) of the "START Inspection Protocol for Continuous Monitoring."
- **2** ***Monitor***. Consults the IP to ensure that the ICE recommendation is consistent with it. Peers into the railcar. He can see nothing but the concealment panel, which from his vantage point appears to be a large container, and therefore cannot verify the absence of an ICM. Consulting the IP again if desired to determine what his alternatives are, he declares that apparently a large container is present.
- **3** ***ICE***. Again offers to allow the monitor to X-ray the contents of the railcar.

- **4 *Monitor*.** Requests that the RAPIDSCAN operators obtain an X-ray scan.

- **5 *RAPIDSCAN Operator*.** Runs the X-ray scan, and displays the resulting file on the RAPIDSCAN computer system screen. The file displayed will reflect complete X-ray signal attenuation caused by placing lead plates over the X-ray detectors. Operator will provide any conclusions which can be made from the display (or lack of a display) to the monitor. In any case, there will be no signature resembling that of an ICM.

- **6 *Monitor*.** Considers the information provided by the RAPIDSCAN Operator and evaluates his options under the IP.

- **7 *ICE*.** Asks the monitor how the industrial equipment looks in the X-ray.

- **8 *Monitor*.** Indicates that the X-ray scan is showing unusual results.

- **9 *ICE*.** He stares at the computer screen and pretends to share in the monitor's bewilderment for a few moments, and then shrugs and informs the monitor that, having completed the inspection as required, he will be sending the cargo through the portal.

As with the second scenario (Concealed Access), an experienced monitor may recognize the possibility of a circumvention (in this case, that shielding is being employed to spoof the X-ray scan) and may make the same argument to continue the inspection and conduct an additional scan elsewhere on the railcar. Again, the ICE should allow him latitude similar to what he will allow in the proof-of-principle case, providing his arguments are sound and his requests are consistent with the inspection protocol.

5.5.8.2 Phase 2. Proof-of-Principle.

The "inspection" is repeated with the help of ITSIP. Steps 1-3 in the Phase I procedure are repeated with the exception that the monitor tracks the progress of the inspection on the ITSIP IP Flowchart, with the help of the ITSIP Operator. The path followed is P1...P3...I...N1...N3...N5...N16...N17...D...C1...C3...C5.

- **1 *Monitor*.** Requests that the RAPIDSCAN operators obtain an X-ray scan.

- **2 *RAPIDSCAN Operator*.** Runs the X-ray scan. Saves the X-ray scan files in the ITSIP "DEMO SCANS" folder mounted on RAPIDSCAN.

- **3 *ITSIP Operator*.** Selects the "Load Present Scan" button, and selects the appropriate X-ray scan file names.

- **4 *Monitor*.** Examines the X-ray trace and is unable to find any signature resembling a missile. This is consistent with what the ICE has told him, but the appearance of the curve is unusual. The monitor starts the X-ray matching function on ITSIP.

- **5** ***ITSIP***. ITSIP examines the signal level and determines that the attenuation is unusually high. ITSIP indicates that the "Deaden" CS may be in use. If desired, the monitor may examine the "Deaden" CS. No determination has been made as to the contents of the railcar, so ITSIP recommends re-running another vertical X-ray scan at another location on the railcar, ten feet further back. (A full height lead plate, two feet wide and thick enough to be capable of nearly complete absorption of the X-ray signal, would weigh about three metric tons; therefore, in order for the host country to cover a +/- 10 foot span with the absorbing lead, a weight increase of 30 MT would have to be incurred, making the technique susceptible to detection by weighing.)

- **6** ***Monitor***. Taking heed of the warning provided by ITSIP, he informs the ICE that without an additional X-ray scan of the railcar at a shifted location, an ambiguity may exist. Requests that the ICE move the railcar forward along the track a distance of ten to fifteen feet.

- **7** ***ICE***. Agrees to move the railcar down-track ten to fifteen feet.

Two separate outcomes from this point forward have been identified. Enactment of both paths in sequence is useful because it demonstrates ITSIP utility. The first path proceeds as follows.

- **8** ***Support Personnel***. They move the railcar down the track about ten feet, aligning the Linatron beam as shown in Figure B-2, position C. The Linatron fan beam still does not intersect with test articles 4A and 4B, and the lead plates are assumed to extend to this point.

- **9** ***Monitor***. Requests that the RAPIDSCAN operators repeat the X-ray scan.

- **10** ***RAPIDSCAN Operator***. Repeats the X-ray scan. Saves the X-ray scan files in the ITSIP "DEMO SCANS" folder mounted on RAPIDSCAN.

- **11** ***ITSIP Operator***. Selects the "Load Repeat Scan" button, and selects the appropriate X-ray scan file names.

- **12** ***Monitor***. Examines the X-ray trace and is unable to find any signature resembling a missile. This is consistent with what the ICE has told him, but the appearance of the curve is unusual. The monitor starts the X-ray matching function on ITSIP.

- **13** ***ITSIP***. ITSIP is unable to find a close match with any of the stored ICM scans, but recognizes unusually high attenuation in the signal again. Again, ITSIP indicates that a "Deaden" CS may be in progress.

- **14** ***ITSIP***. ITSIP recommends to the monitor that he request permission to weigh the railcar but notifies the monitor that the ICE is not obligated to comply with this request by the Inspection Protocol.

- **15** ***Monitor***. Indicates that the X-ray results are indeterminate and informs the ICE that weighing of the railcar is needed to ensure treaty compliance.

- **16** ***ICE***. Agrees to allow weighing of the railcar.

- **17** ***ITSIP Operator*.** Presses RETURN button to exit the current IP flowchart page. On Page C, turns the OVERRIDE switch ON and presses the "YES" button preceding node N6-9(c).

- **18** ***Monitor*.** Enters the "measured" weight, which is provided by the Demonstration Director with reference to Table B-3. The value entered is 184 metric tons. (A +/- 10 foot lead plate is assumed to be in use.) The monitor then enters the tare weight of the railcar (50 metric tons), also provided by the Demonstration Director from Table B-3.

It may be argued that the ICE, under these circumstances, would not agree to weighing of the railcar. There is some possibility that human error or lack of knowledge about the circumvention and the portal capabilities might cause him to agree to weighing. However, even if he does not, the ITSIP capability will be useful to support an amendment to the IP in a JCIC meeting. The key feature of ITSIP in this case is the recognition of the connection between the absorbed X-ray signal and the need to weigh the railcar.

- **19** ***ITSIP*.** Recognizes that the entered weight is very high, larger than the expected combined weight of an SS-25 and a railcar. Indicates that this weight supports the possibility that the "Deaden" CS is in use. Recommends inspection of the interior of the railcar.

The second possibility continues after step 8 in Phase 2. It presupposes that the attenuating material does not extend to the area of the new scan, and requires that the lead plates blocking the X-ray detectors be removed and that the railcar be moved again, permitting Test Articles 4A and 4B to be scanned. Also, the ITSIP operator will return the ITSIP system to its status as of step 8. After doing so, the inspection proceeds as follows.

- **20** ***Monitor*.** Requests that the RAPIDSCAN operators repeat the X-ray scan.

- **21** ***Support Personnel*.** They remove the lead blocking plates from the X-ray detectors. Then they move the railcar down the track about five feet, aligning the Linatron beam with test articles 4A and 4B as shown in Figure B-2, position B.

- **22** ***RAPIDSCAN Operator*.** Repeats the X-ray scan. Saves the X-ray scan files in the ITSIP "DEMO SCANS" folder mounted on RAPIDSCAN.

- **23** ***ITSIP Operator*.** Selects the "Load Repeat Scan" button, and selects the appropriate X-ray scan file names.

- **24** ***Monitor*.** Examines the X-ray scan. This time the appearance of a trace is recognizable. The monitor starts the X-ray matching function on ITSIP.

- **25** ***ITSIP*.** Determines that the X-ray scan closely matches the signature of an SS-25, and displays this finding for the monitor.

5.5.8.3 End of Demonstration.

5.6 DEMONSTRATION NUMBER FIVE: NON-CIRCUMVENTION.

5.6.1 Introduction.

This demonstration involves a case where the ICE is bringing a railcar that does not contain an ICM through the portal. It is introduced to represent the likely situation in which no circumvention is being attempted at the portal, and to avoid the preconception by the monitors that all demonstrations must necessarily involve a circumvention.

5.6.2 ITSIP Objective.

ITSIP will assist the monitor in following the inspection protocol and will indicate that no known ICMs are present based on comparison of the X-ray signature of the railcar with its cargo to stored signatures.

5.6.3 Measure of Effectiveness For This Demonstration.

ITSIP should declare that the railcar does not appear to contain an item of continuous monitoring, although possible CSs may be indicated for the monitor to consider.

5.6.4 Required Equipment.

Item	Notes
Railcar	
Overhead Projector	Set up in Radiography Lab
Projection Screen	Set up in Radiography Lab
Concealment Tarpaulin for Railcar	See Figure B-2
Apple Image Writer II Printer	TASC will provide data cables; Raytheon to provide power cord
Desk Lamp(s) for Radiography Lab	As required to operate radiography equipment without ceiling lights
Radiography Equipment	All equipment needed to generate an X-ray scan
Macintosh System 7 Operating System or suitable file sharing software (e.g., TOPS)	Required for file transfer (TASC will provide cables)
Cardboard Placard Labeled "SHIPPING CRATE"	Stenciled letters at least 4" high
Cardboard Placard Labeled "NO ICBM PRESENT"	Stenciled letters at least 4" high

5.6.5 Site Preparation and Demonstration Set-Up.

Advance Preparation:

- Configure the concealment tarpaulin in the railcar as shown in Figure 2. Test articles 4A and 4B, while not required for this demonstration, may be left in the railcar if desired to simplify the set-up.

Pre-Demonstration Preparation:

- Disable or switch off TV monitors allowing viewing of railcar from top or far side of radiography area.

- Position the railcar within the radiography area with the doors facing North (away from the Linatron.) Railcar should be positioned longitudinally so that a portion of the car which is free of test items is aligned with the fan beam of the Linatron.

- Place the label placard marked "NO ICBM PRESENT" next to test articles 4A and 4B so that the lettering would be visible to an observer outside the open doors of the railcar if the tarpaulin were not in place. This placard may be secured to the test articles or holding stand if required. Place one of the label placards marked "SHIPPING CRATE" between the tarpaulin and the doors of the railcar, securing it to the tarpaulin if necessary to hold it in place, so that it is readable to an observer standing outside the open doors of the railcar.

- Close the doors of the railcar.

- Prepare the RAPIDSCAN computer to transfer files to ITSIP with the TOPS software by mounting the folder named "DEMO SCANS" from ITSIP after it is published by the ITSIP operator.

In-Demonstration Support:

- Open the doors of the railcar.

- Take an X-ray scan of the railcar.

5.6.6 Personnel Support.

One (1) RAPIDSCAN Operator, two (2) Monitors, two (2) Support Personnel, one (1) ITSIP Operator, and one (1) In-Country Escort (ICE).

5.6.7 Estimated Demonstration Duration.

Two hours.

5.6.8 Demonstration Event Sequence.

5.6.8.1 Phase 1: Baseline Performance.

The monitors perform the inspection without ITSIP.

- **1 *ICE*.** Declares that a railcar is present that does not contain an ICM – merely new commercial products being produced at the factory. He opts to allow viewing of the interior of the vehicle per paragraph 9(d) of the "START Inspection Protocol for Continuous Monitoring."

- **2 *Monitor*.** Consults the written START IP to determine whether he has any other alternatives. Agrees to view interior of the vehicle.

- **3 *Support Personnel*.** They open the doors of the railcar.

- **4 *Monitor*.** Declares that he cannot verify the absence of an ICM, since a container is present which appears to be large enough to contain an ICM. (The concealment tarpaulin represents a large shipping container as indicated in Table B-3.) Asks to view the interior of the container.

- **5 *ICE*.** Does not allow viewing of the interior of the container – contends that opening the container is too difficult and expensive. Offers to permit non-destructive imaging of the contents.

- **6 *Monitor*.** Again consults the START IP. Instructs RAPIDSCAN operators to image the contents of the "container" as it stands within the railcar. This will be the last procedure allowed in the inspection.

- **7 *RAPIDSCAN Operator*.** Operates the RAPIDSCAN equipment as required to X-ray the contents of the "container." Displays the resulting image for viewing by the monitor. The signal will not resemble the signature of any ICM. Operator will provide monitor with any conclusions which can be made by looking at the X-ray trace.

- **8 *Monitor*.** Without apparent evidence that an ICM is contained in the railcar, monitor is unlikely to report a possible ambiguity.

5.6.8.2 Phase 2: Proof-of-Principle.

The "inspection" is repeated with the help of ITSIP. Steps 1-6 of the inspection above are repeated with the exception that the monitor tracks his progress through the inspection protocol by clicking on the appropriate path on the ITSIP representation of the Inspection Protocol Flowchart. (ITSIP operators will provide "help" to the monitor in tracking the flowchart in ITSIP.) The path taken is P1...P3...I...N1...N3...N5...N16...N17...D...C1...C3...C5.

- **1 *RAPIDSCAN Operator*.** Operates the RAPIDSCAN equipment as required to X-ray the contents of the "container." Saves the X-ray scan files in the ITSIP "DEMO SCANS" folder mounted on RAPIDSCAN.

- 2 ***ITSIP Operator***. Selects the "Load Present Scan" button, selects the appropriate X-ray scan file names, and then starts the X-ray matching function on ITSIP.

- 3 ***ITSIP***. Processes the file by comparing the scanned data to each of its reference ICM signatures, including scaling factors. It finds that the scan does not match any of the reference signatures and has low attenuation relative to X-ray scans of ICMs. Consequently, it eliminates all ICMs from the list of possible ICMs. Possible CSs, which are consistent with a low attenuation X-ray scan, may yet be indicated by ITSIP.

5.6.8.3 End of Demonstration.

ANNEX A TO APPENDIX B

LIST OF ACRONYMS

CS	Circumvention Scenario
DNA	Defense Nuclear Agency
IAW	in accordance with
ICBM	Inter-Continental Ballistic Missile
ICE	In-Country Escort
ICM	Item of Continuous Monitoring
INF	Intermediate Nuclear Force(s)
IP	Inspection Protocol
ITSIP	Innovative Treaty Sensor Integration Project
MOE	measure of effectiveness
SICBM	Small Inter-Continental Ballistic Missile
START	Strategic Arms Reduction Treaty
TASC	The Analytic Sciences Corporation
TLI	Treaty Limited Item
TOPS	Macintosh System 7 Operating System
TOSI	Technical On-Site Inspection (Facility)
TSAM	Treaty Scenario Analysis Methodology
TV	television

ANNEX B TO APPENDIX B

SELECTED TSAM CIRCUMVENTION SCENARIOS

1.1 GENERAL.

This Annex presents the four (4) different Circumvention Scenarios (CS) used during each of the proof-of-principle evaluation of the ITSIP program. The four CSs used in this phase were deemed sufficient to demonstrate the utility of the ITSIP tool and methodology at the proof-of-principle stage.

The five (5) demonstrations used to demonstrate the utility of ITSIP, and the CS used to support each proof-of-principle phase are:

DEMONSTRATION NUMBER	CS NUMBER	CIRCUMVENTION SCENARIO (CS) NAME
ONE	8a	Offset Variant Plus
TWO	3	Concealed Access
THREE	11	False Shell
FOUR	1	Deaden
FIVE	N/A	Non-Circumvention

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM) 94-0464.22

CIRCUMVENTION SCENARIO (CS) NO. 8a **NICKNAME:** Offset Variant Plus

RANK: 2
TOTAL SCORE: 10.51
CS SCORE: 3.51
ITSIP VALUE: 3.00
TOSI VALUE: 4.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The ICE claims that a new tactical missile-smaller than the SS-25 and not constrained by the START or INF Treaties-is being built at Votkinsk. The missile, assembled and transported in a launch canister, is loaded in a railcar that arrives at the portal. The missile has been offset to the side of the car away from the linatron X-ray source, but is packed in the large crate that conceals its positioning within the car. The ICE allows the car to be X-rayed. The image produced reveals the profile of a missile that is smaller than an SS-25.

FEASIBILITY ISSUES: None.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ☐ Undeclared New Variant Or Version
- ☐ Increase In Throw-weight
- ☐ Increase In Warhead Loading
- ☐ Other ______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
☐ High ☐ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- ☐ Emerging Democracy
- ◩ Chaos
- ■ Oligarchy
- ■ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

The inspector notes that it is unusual for an SS-25 to be shipped in a container other than a launch canister and enters this observation into ITSIP. ITSIP will recommend that the monitor request ICE permission to view the interior of the container, which will be denied. The inspector will be suspicious but will be obligated to allow the railcar to exit. (If strain gauges were attached to the rails, they would indicate the asymmetry of the load.) ITSIP will note that the inspector can recommend to his superiors that the question of a new missile-not contained in its database-which might be a strategic offensive weapon be clarified by the Joint Compliance and Inspection Commission.

FEASIBILITY ISSUES:
None

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ■ Yes ☐ No ☐ Possibly

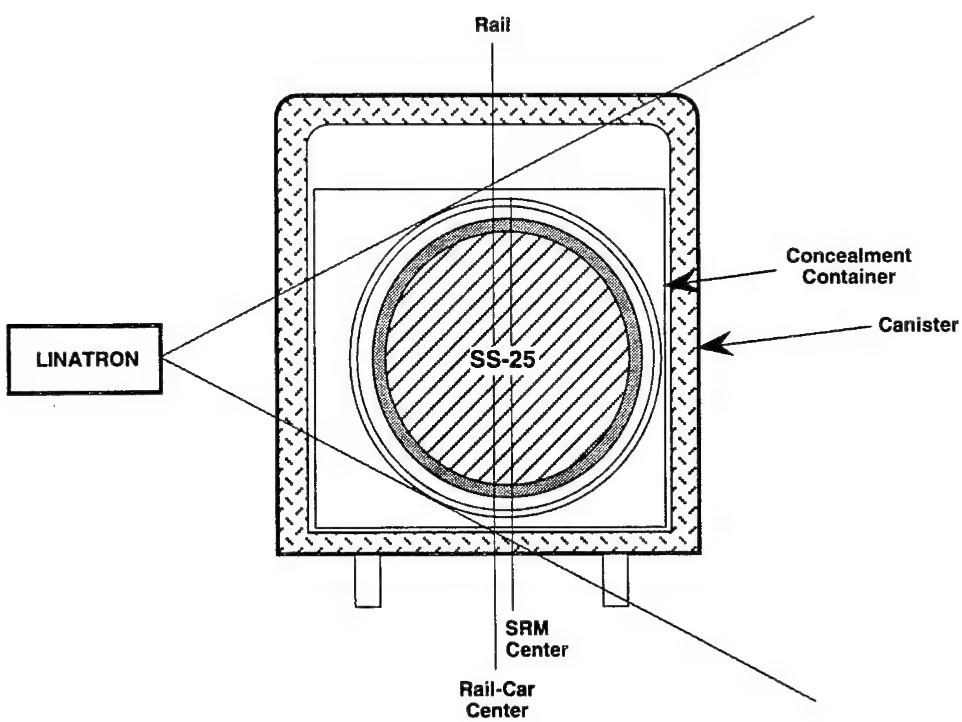
DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	☐ A.I.
☐ Weight	☐ NTM
☐ Size Measurement	■ Other Strain Gauge
■ Visual Observation	☐ Other ______
☐ Other ______	☐ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ■ Yes ☐ No

TREATY APPLICABILITY:
- ☐ CWC/CW
- ☐ Open Skies
- ☐ NPT
- ■ START Follow-on
- ☐ CFE
- ☐ Other ______



Demonstration 1. Circumvention scenario no. 8a: offset variant plus.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

94-0464.11

CIRCUMVENTION SCENARIO (CS) NO. 3 **NICKNAME:** Concealed Access

RANK: 3
TOTAL SCORE: 9.25
CS SCORE: 3.25
ITSIP VALUE: 4.00
TOSI VALUE: 2.00

CIRCUMVENTION TECHNIQUE DESCRIPTION:

An SS-25 road mobile ICBM in excess of the numerical limit on non-deployed mobile ICBMs has been produced. The SS-25 has been lowered into a rail-car with a specially designed removable top which is then reattached is such a way as to hide its purpose. The only other apparent "doors" allowing access into the rail-car have a width of 1.5m, which is smaller than the 1.8m size criteria in Para 3 of Annex 12 to the Protocol. Therefore, at the portal, the ICE allows only measurement of the "accesses" into the vehicle. (This technique could also be used to ship SS-24s; however, at the SS-24 plant, challenge inspections for first stages may be invoked by the monitor.)
Without a change in the protocol, this is virtually a foolproof technique.

FEASIBILITY ISSUES:

No significant issues.

INSPECTION PROTOCOL SEQUENCE:

P1→P3→I→N2→N7→END

CATEGORY OF START AMBIGUITY:

- ■ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- ■ Increase In Throw-weight
- ■ Increase In Warhead Loading
- □ Other______

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

□ High □ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

□ Emerging Democracy ■ Chaos
◪ Oligarchy ◪ Russian Dictatorship

DETECTION TECHNIQUE DESCRIPTION:

The inspection procedure of measuring the access activates a warning flag on the ITSIP: What if a larger concealed access is present? ITSIP recommends to the monitor to declare the roof as a "door" and proceed with the inspection by viewing the interior of the vehicle. If permission is denied, ITSIP will recommend obtaining permission to perform an X-ray scan and then permission to weigh the vehicle. If all these procedures are denied, ITSIP will indicate a high probability of treaty ambiguity, particularly if this is inconsistent with past ICE behavior.

FEASIBILITY ISSUES:

No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

DETECTION METHODS

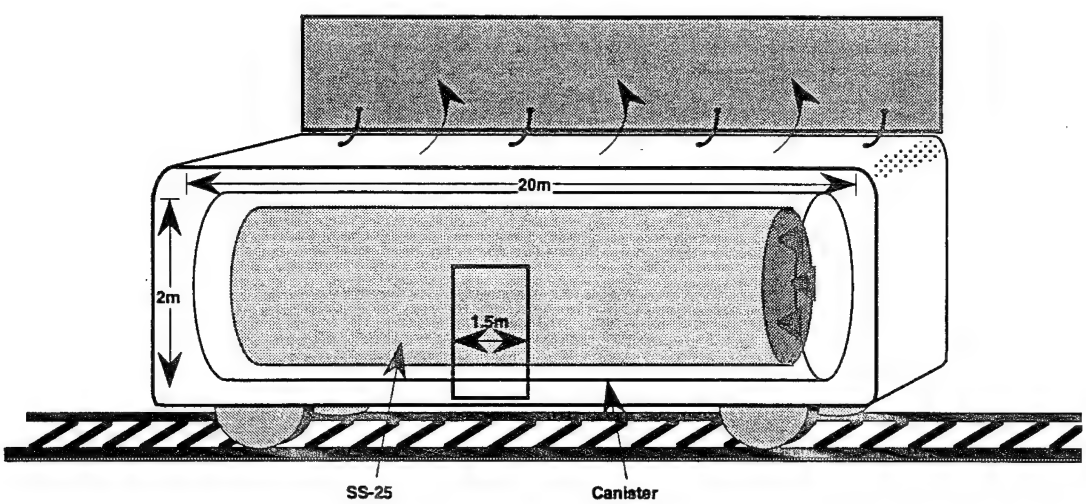
TOSI	NEW/SIMULATED
■ X-ray	■ A.I.
■ Weight	□ NTM
■ Size Measurement	□ Other ______
■ Visual Observation	□ Other ______
□ Other ______	□ Other ______

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? □ Yes ■ No

TREATY APPLICABILITY:

□ CWC/CW □ Open Skies ■ NPT
■ START Follow-on □ CFE □ Other ______



Demonstration 2. Circumvention scenario no. 3: concealed access.

94-0464.27

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

CIRCUMVENTION SCENARIO (CS) NO. 11 **NICKNAME:** False Shell

RANK: 8
TOTAL SCORE: 6.41
CS SCORE: 2.00
ITSIP VALUE: 3.00
TOSI VALUE: 1.41

CIRCUMVENTION TECHNIQUE DESCRIPTION:

SS-24s (rail-mobile) are being assembled in excess of the numerical treaty limitations (125) on non-deployed rail-mobile ICBMS. The SS-24s are placed inside shells fabricated in the same dimensions as a new version of the SS-18 which has been fabricated for space use and previously declared. Thus the SS-24s appear visually to be SS-18s. The ICE declares that the portal inspectors may view the "SS-18X" from the end of the "SS-18X launch canister."

FEASIBILITY ISSUES:

No significant issues.

INSPECTION PROTOCOL SEQUENCE:

P1→P3→I→N1→N3→N5→N16→N18→N19→E→L2→L6→END

DETECTION TECHNIQUE DESCRIPTION:

ITSIP becomes suspicious because its database indicates that production of SS-18Xs, is extremely rare. ITSIP recommends that the monitor request permission from ICE to weigh the railcar. If permission is granted, the weight may be inconsistent with the ITSIP calculated weight of an empty SS-18X. ITSIP also recommends that the monitor request permission from ICE to X-ray the canister. If this is allowed, it will show a missile SRM casing diameter inconsistent with an SS-18X and consistent with an SS-24. Denial of permission to perform these procedures will increase the suspicion of ITSIP.

FEASIBILITY ISSUES:

No significant issues.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? ☐ Yes ☐ No ■ Possibly

CATEGORY OF START AMBIGUITY:

- ■ Production Limit On Mobile ICBMs Exceeded
- ☐ Undeclared New Variant Or Version
- ☐ Increase In Throw-weight
- ☐ Increase In Warhead Loading
- ☐ Other________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:

☐ High ■ Medium ☐ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:

■ Emerging Democracy ☐ Chaos
■ Oligarchy ■ Russian Dictatorship

DETECTION METHODS

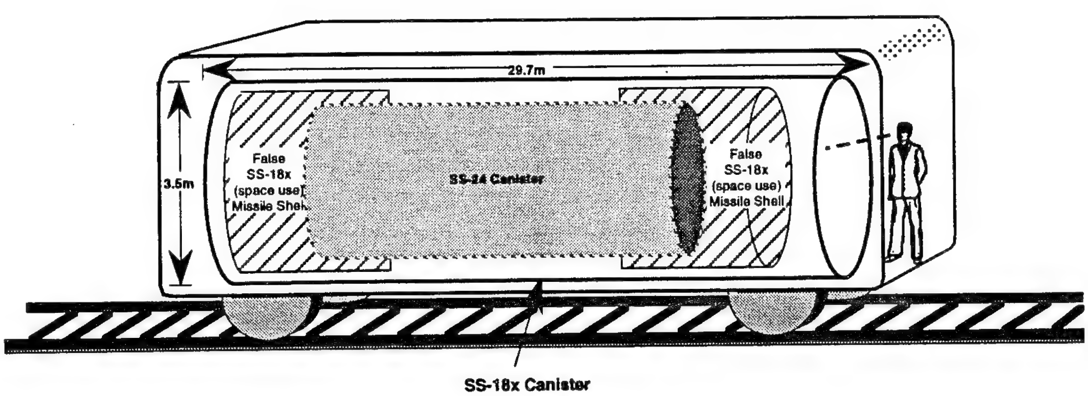
TOSI	NEW/SIMULATED
■ X-ray	☐ A.I.
■ Weight	☐ NTM
■ Size Measurement	■ Other Production History ~~Database~~
■ Visual Observation	■ Other ~~ICE Behavior~~
☐ Other ______	☐ Other Database

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ☐ Yes ■ No

TREATY APPLICABILITY:

☐ CWC/CW ☐ Open Skies ■ NPT
■ START Follow-on ☐ CFE ☐ Other ______



Demonstration 3. Circumvention scenario no. 11: false shell.

TASC TREATY SCENARIO ANALYSIS METHODOLOGY (TSAM)

94-0464.7

CIRCUMVENTION SCENARIO (CS) NO. 1 **NICKNAME:** Deaden

RANK: 11
TOTAL SCORE: 5.96
CS SCORE: 2.51
ITSIP VALUE: 1.00
TOSI VALUE: 2.45

CIRCUMVENTION TECHNIQUE DESCRIPTION:

The inspected party is shipping SS-24 missiles of the rail-mobile type from the missile assembly facility in violation of treaty ceilings.

Thick lead plates have been inserted on either side of the missile canister to absorb the X-ray signal.

FSU ICE claims that U.S. system is defective, and presses on with the movement of SS-24s despite U.S. on-site objections.

FEASIBILITY ISSUES:
Full length lead plates may be too heavy to be practical. This technique could quickly arouse the suspicion of the monitors.

INSPECTION PROTOCOL SEQUENCE:
P1→P3→I→N1→N3→N5→N16→N17→D→C1→C3→C5→END

DETECTION TECHNIQUE DESCRIPTION:

Although the data obtained by the X-ray sensors is inconclusive, the low signal level, combined with a normal signal level at the reference detector, is cause for suspicion. As a response, ITSIP may recommend running an X-ray scan at a higher energy setting on the Linatron. (If weighing or measurement of the seismic signature is permitted, high weight or unusual vibration provides confirming evidence of a possible violation.) ITSIP warns the inspector of excessive X-ray attenuation and indicates high probability of an ambiguity.

FEASIBILITY ISSUES:
Configuration of the X-ray system may not permit the energy level to be changed readily.

AMEND INSPECTION PROTOCOL IN FOLLOW ON NEGOTIATIONS? □ Yes □ No ■ Possibly

CATEGORY OF START AMBIGUITY:
- ■ Production Limit On Mobile ICBMs Exceeded
- ■ Undeclared New Variant Or Version
- □ Increase In Throw-weight
- □ Increase In Warhead Loading
- □ Other________

CIRCUMVENTION TECHNIQUE SOPHISTICATION LEVEL:
□ High □ Medium ■ Low

FSU POLITICAL SCENARIO DOMINANCE FOR THIS CS:
- □ Emerging Democracy
- ■ Chaos
- ◩ Oligarchy
- ◩ Russian Dictatorship

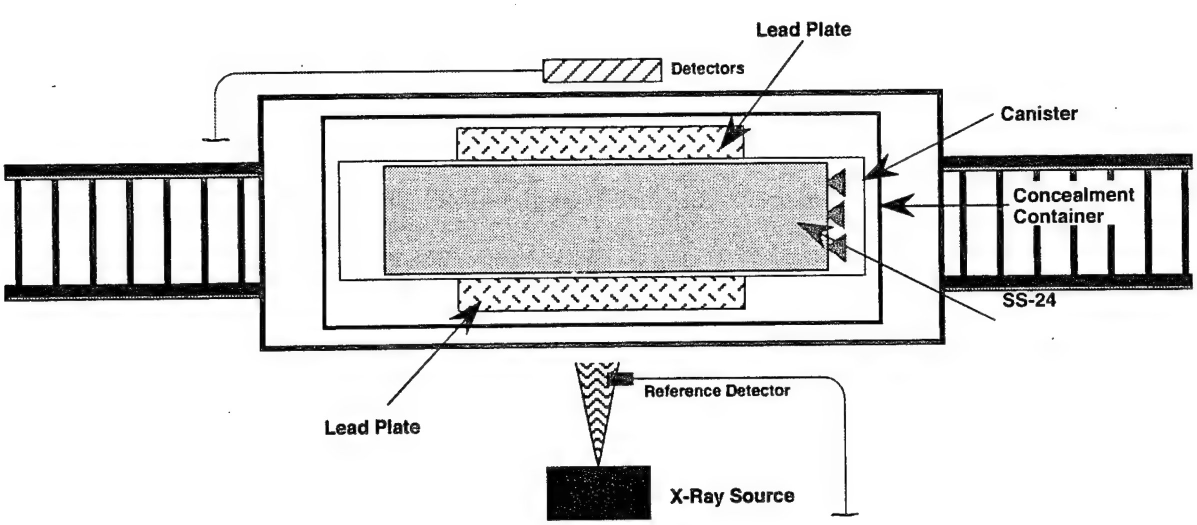
DETECTION METHODS

TOSI	NEW/SIMULATED
■ X-ray	□ A.I.
■ Weight	□ NTM
□ Size Measurement	■ Other Seismic Sensor
□ Visual Observation	□ Other ________
□ Other ________	□ Other ________

START INSPECTION TYPE: Continuous Monitoring

TESTABLE AT TOSI? ■ Yes □ No

TREATY APPLICABILITY:
□ CWC/CW □ Open Skies ■ NPT ■ START Follow-on □ CFE □ Other ______



Demonstration 4. Circumvention scenario no. 1: deaden.

ANNEX C TO APPENDIX B

INSPECTION PROTOCOL FLOW DIAGRAMS

1.1 GENERAL.

Flowcharts show the sequential stages required to perform the inspection, to include decisions and alternatives needed to direct the inspection under certain conditions. The major elements were derived from Annex 5, "Procedure for Continuous Monitoring," of the "Protocol on Inspections and Continuous Monitoring Activities Relating to the [START I] Treaty..."

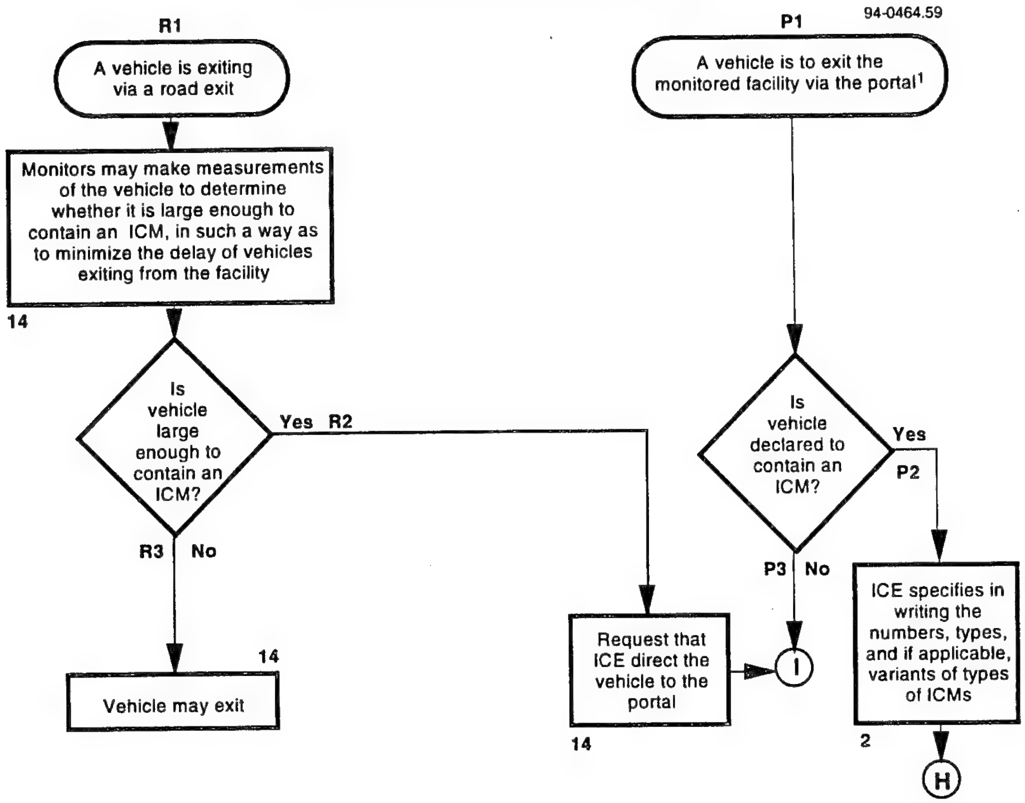
Rectangular boxes describe the procedures, condensed from Annex 5 of the START Treaty Protocol. The procedures are usually measurements, such as weighing the vehicle, or observations, such as viewing the interior of a railcar. These procedures usually result in data being collected and recorded. In a few cases, procedures invoke other actions such as directing a vehicle to a portal.

The diamond shaped icons, referred to as "decision nodes," contain questions with one or more than one possible outcomes. These decisions involve the continued progress of the inspection and are made by the "Treaty Monitor" for some decision nodes, and by the "In-Country Escort" for other decision nodes.

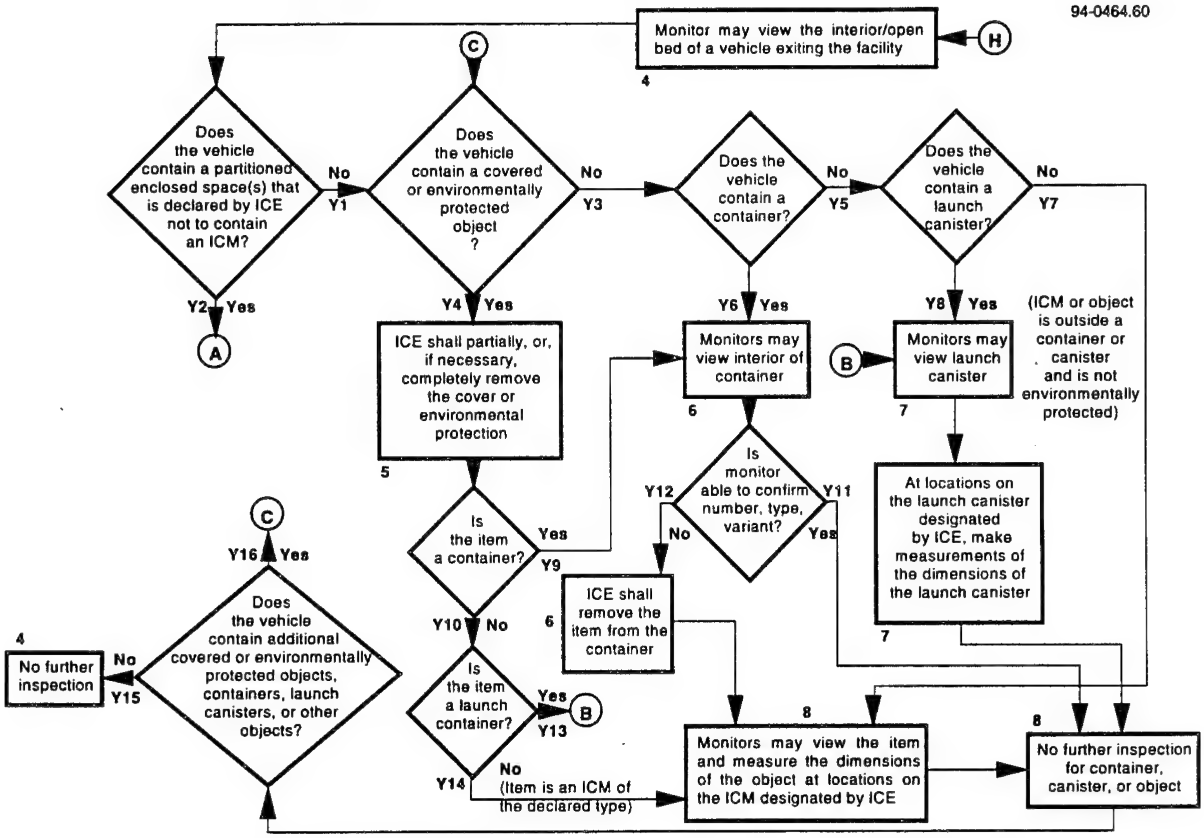
Letters shown in small circles are entry points and continuation points transitioning to other pages.

These Inspection Protocol Flow Diagrams were used as the basis for the ITSIP computer software graphical user interface.

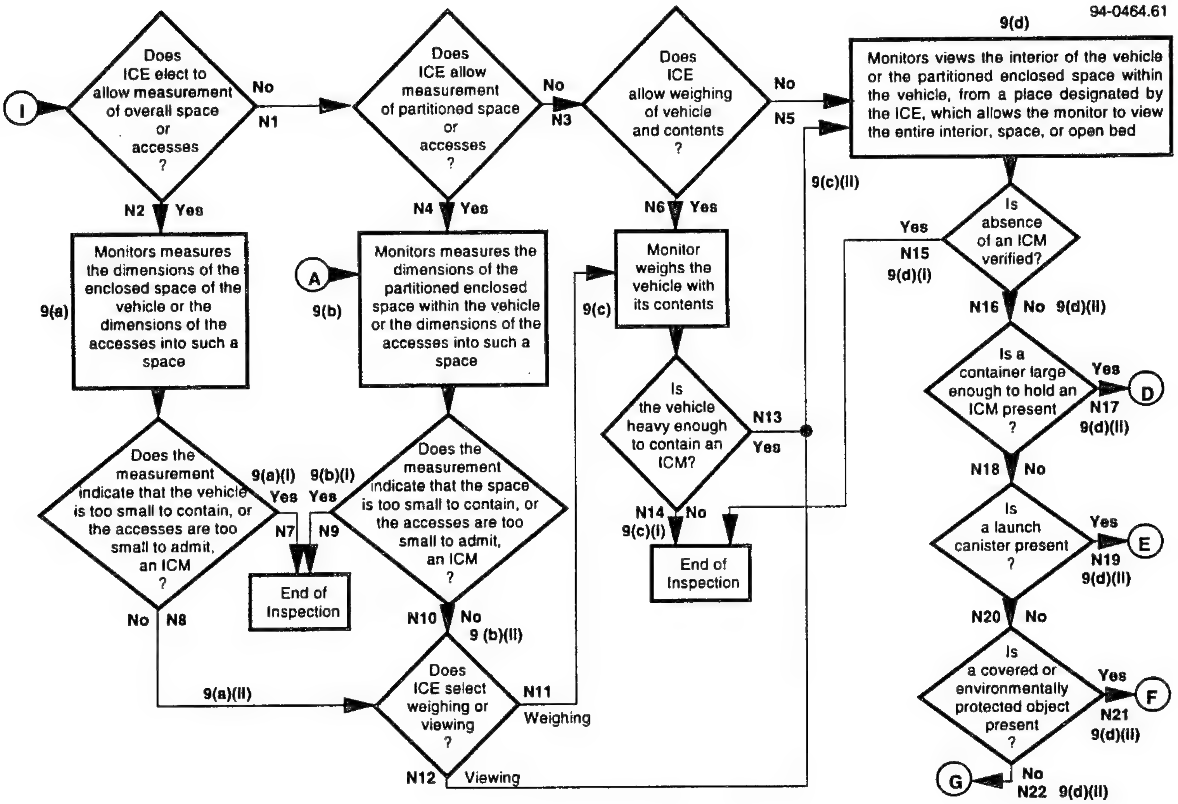
Continuous monitoring protocol.



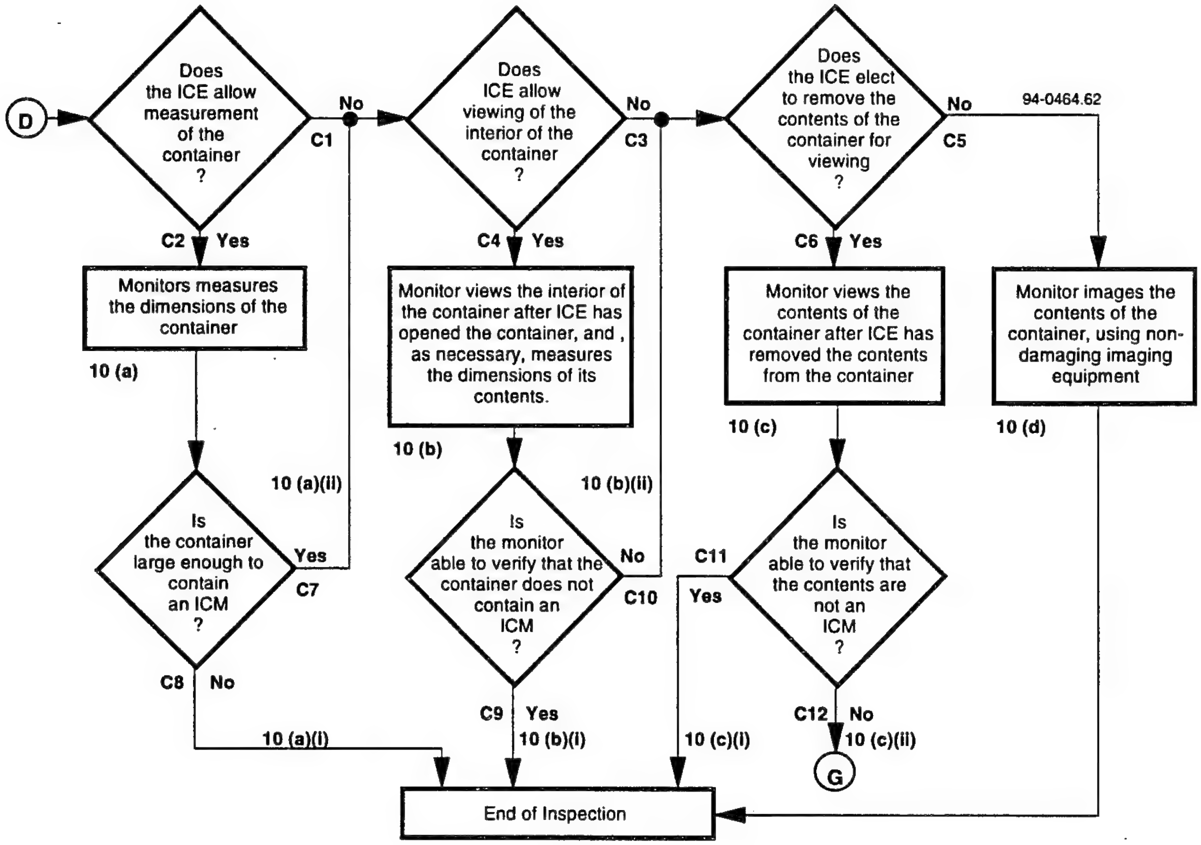
Confirm numbers, types, and variants of types of ICMs.



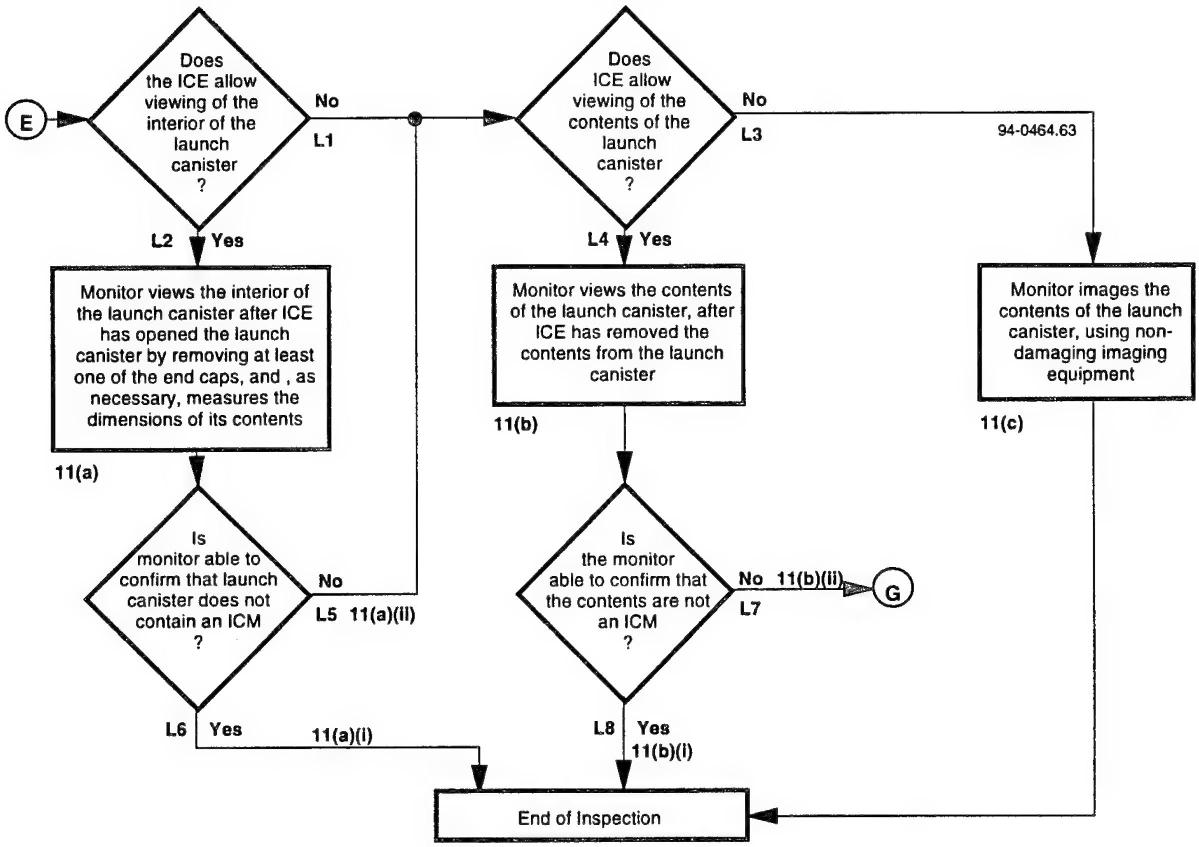
Confirm that no ICM is present in the vehicle.



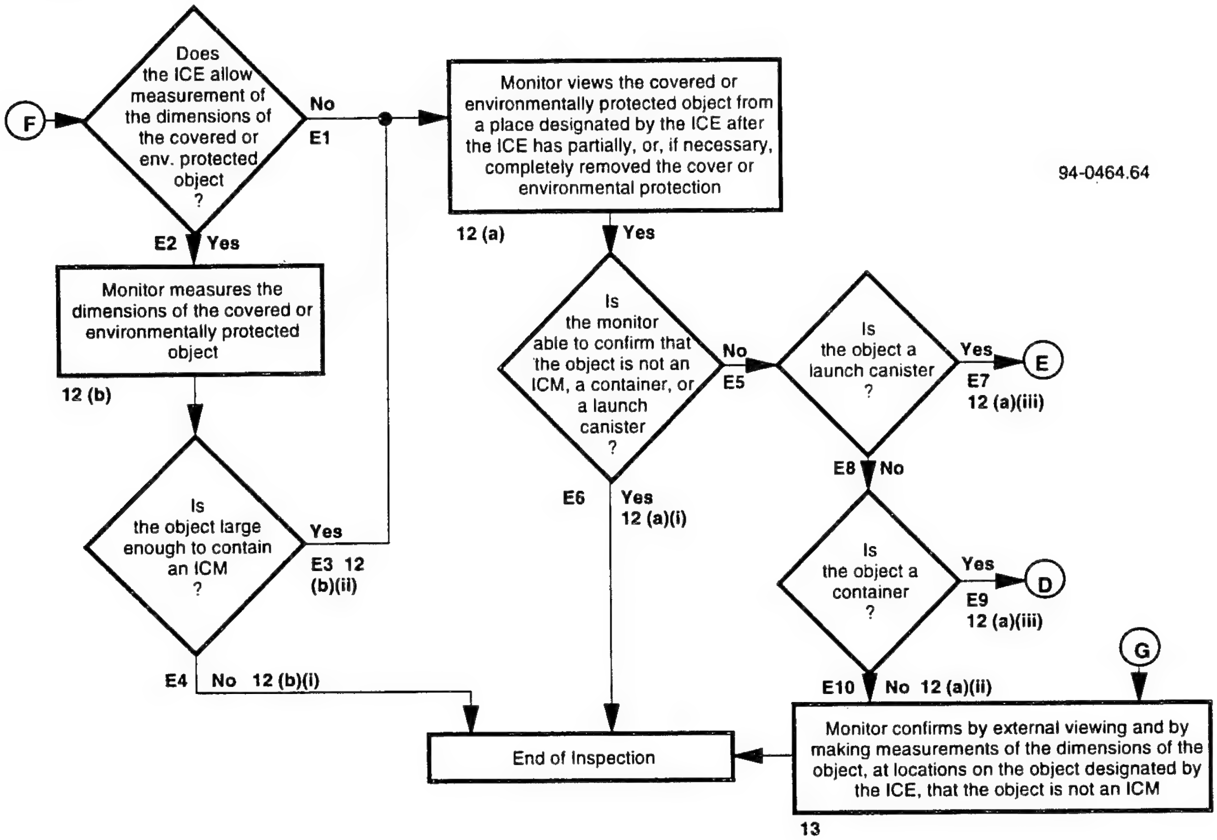
Verification that a container does not contain an ICM.



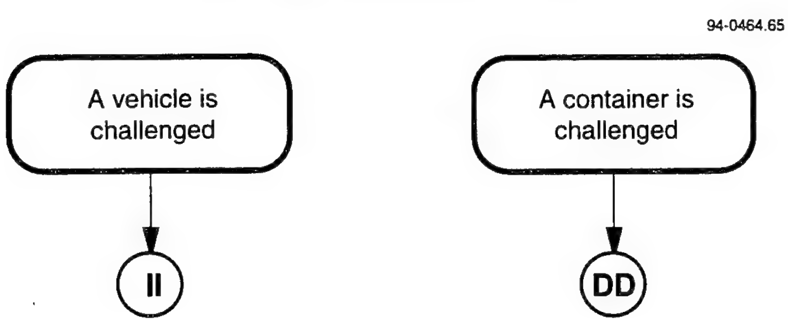
Verification that a launch canister does not contain an ICM.



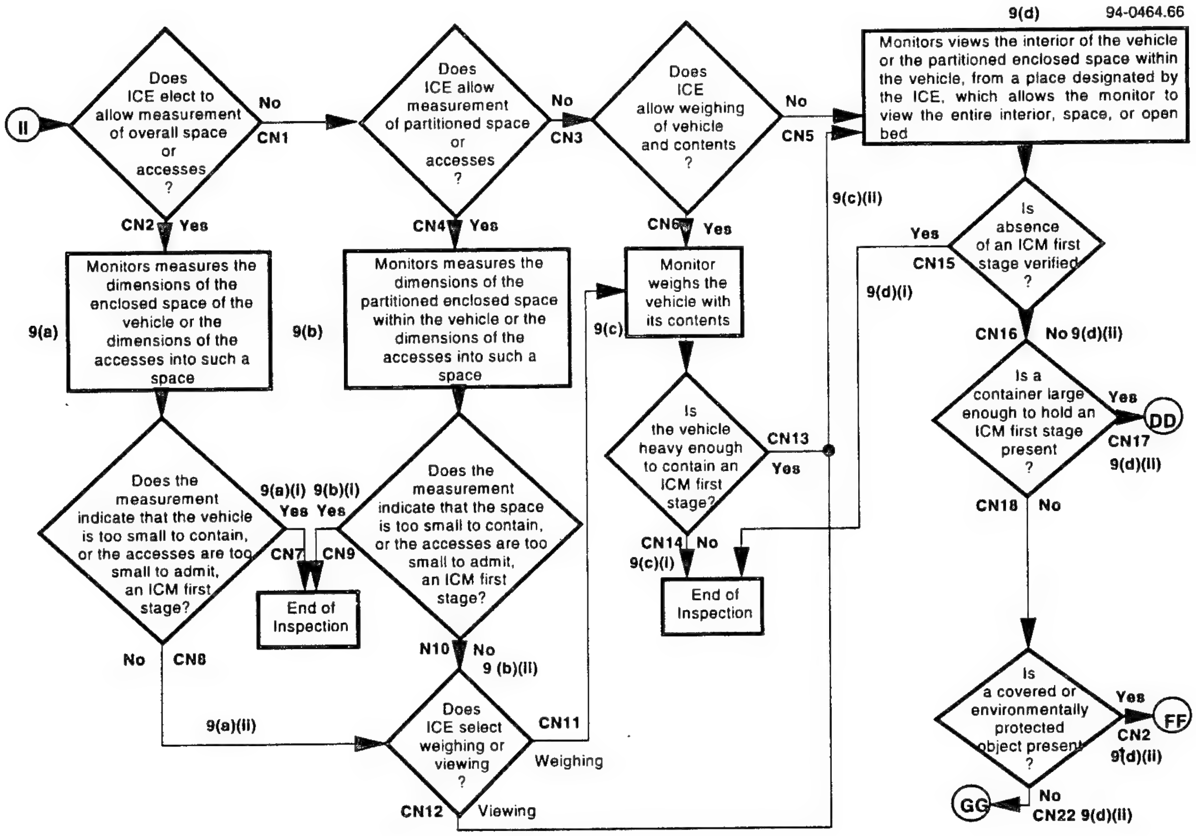
Verification that a covered or environmentally protected object, or an unidentified object, is not and does not contain an ICM.



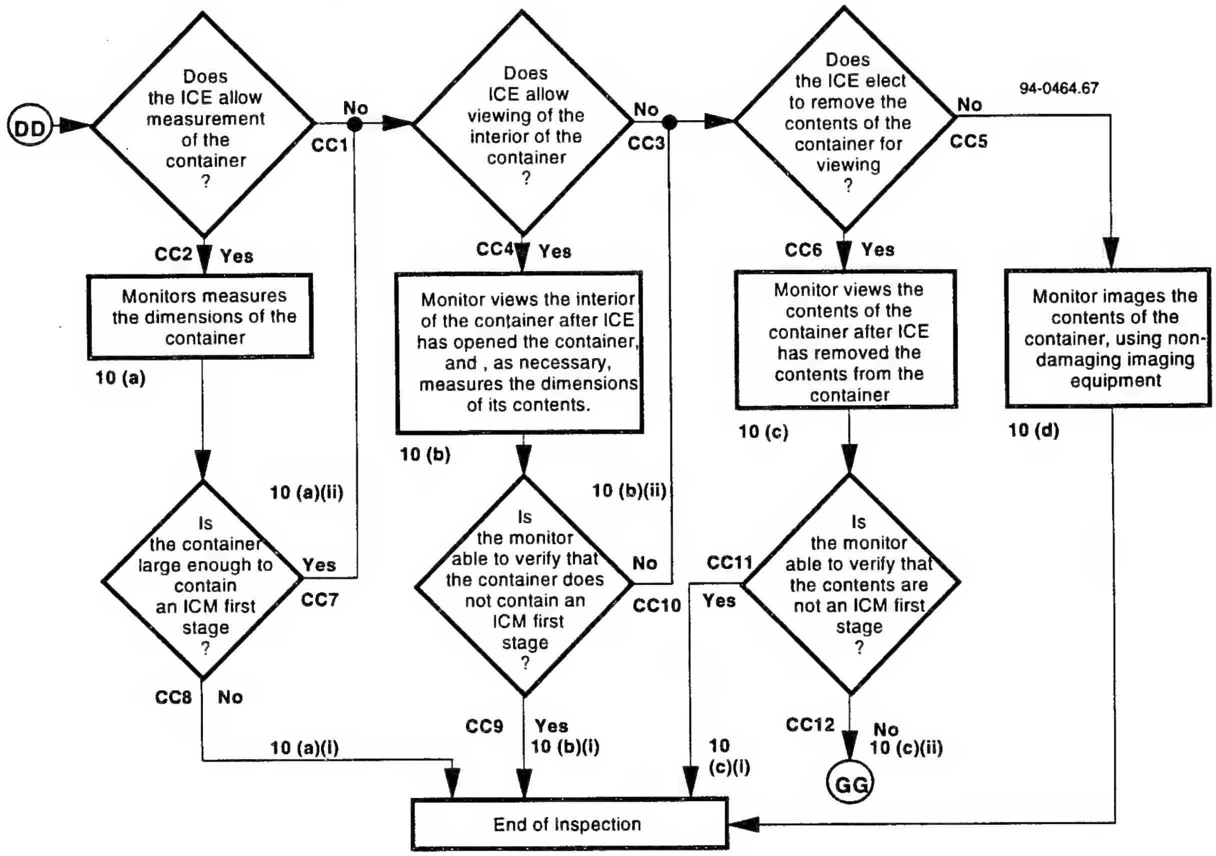
Challenge inspection protocol.



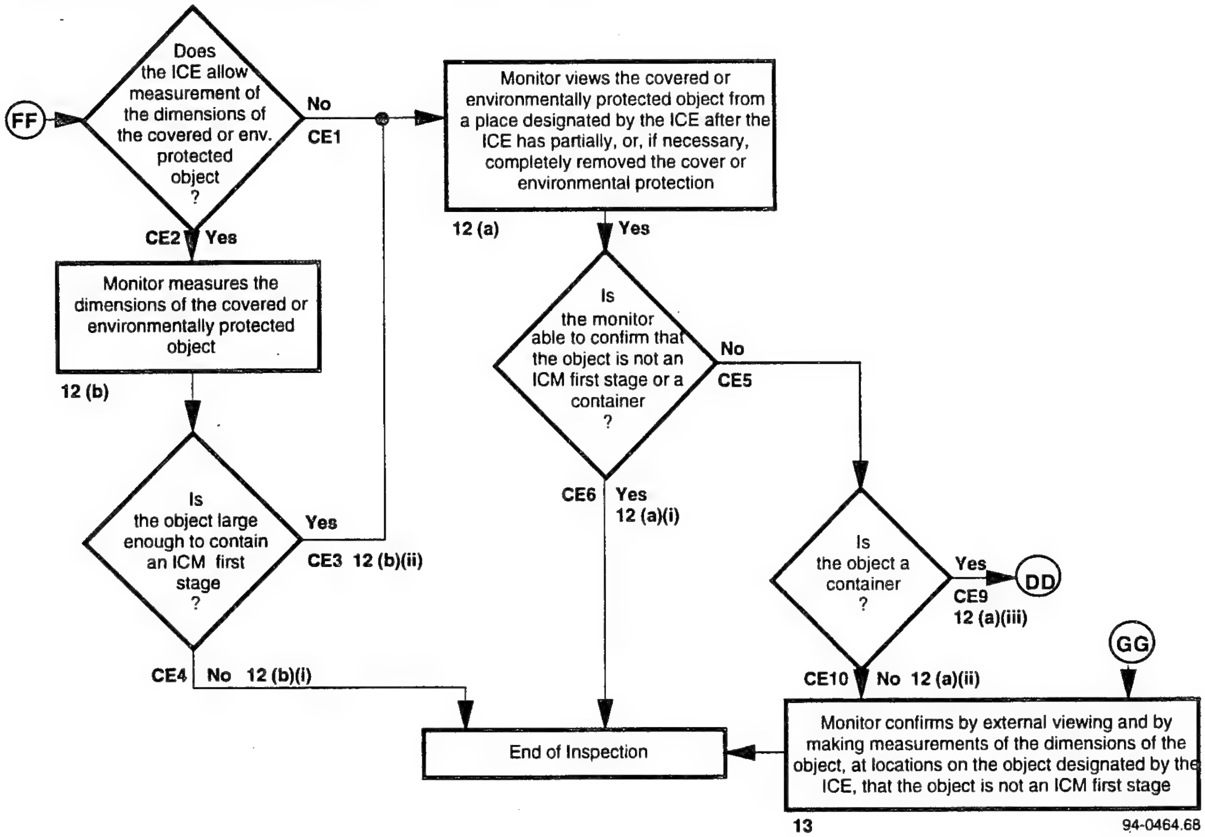
Confirm that no ICM first stage is present in the vehicle.



Verification that a container does not contain an ICM first stage.



Verification that a covered or environmentally protected object, or an unidentified object, is not and does not contain an ICM first stage.



APPENDIX C

EXTENSION OF ITSIP TO OTHER TREATY AREAS

APPENDIX C

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX C

EXTENSION OF ITSIP TO OTHER TREATY AREAS

1.1 INTRODUCTION.

The Innovative Treaty Sensor Integration Project (ITSIP) is being conducted by the Analytic Sciences Corporation (TASC) for the Defense Nuclear Agency (DNA) under contract number DNA 001-91-C-0149. ITSIP's objective is to demonstrate the utility of advanced information technology, sensor integration, and artificial intelligence to arms control treaty monitoring and verification applications. Originally, a START Treaty portal monitoring scenario was selected to demonstrate the system's capabilities to the proof-of-principle level. This paper has been written at the request of DNA to discuss actions required to explore in a more formal and definitive way the utility of an ITSIP-type system in a multi-treaty environment: notably, the Chemical Weapons Convention (CWC), Cooperative Threat Reduction (CTR)/Nuclear Non-Proliferation Treaty (NPT), and Open Skies Treaty.

1.2 STATUS OF ITSIP TODAY.

The ITSIP project got under way on 11 March 1992. The project plan included three tasks. The first task, which began on 11 March 1992 and ran through January 1993, was Requirements Analysis and System Architecture. Task 2 was System Fabrication. Task 3, Proof of Principle Demonstration and Evaluation, centered on a field demonstration of the system at the Testbed for ARMS Control Technology (TACT) facility at Kirtland Air Force Base, New Mexico, in February 1994. During development, project briefings and system demonstrations have been given to officials in the Defense Nuclear Agency, the On-Site Inspection Agency (OSIA), and the Office of the Secretary of Defense (OSD). ITSIP demonstrations were conducted and very favorably received during the DNA Arms Control Conference in June 1993.

The utility of an ITSIP-type system for more effective arms control agreement verification has already been generally recognized by DNA and OSD. Arms control verification is typically data-intensive; it frequently involves the repetitive performance of relatively mundane tasks that can be mind-numbing to all but the most alert and dedicated inspector. The major contributions of ITSIP-type systems in this environment are summarized in Table C-1, ITSIP Contributions to Arms Control Verification.

Table C-1. ITSIP contributions to arms control verification.

INSPECTOR REQUIREMENTS	ITSIP CAPABILITIES
Understand and follow sometimes complex inspection procedures	Interactive flow diagrams highlight present status of inspection; illustrate relationship to other parts of inspection
Exploit opportunities that may arise going beyond established procedures	Flow diagrams have override capability to deviate from norm; ITSIP recommends most effective procedures
Recognize/identify treaty limited items	Automatic comparison of present measurements with TLI characteristics in ITSIP database
Compare observations from as many sources as possible: measurements, sensors, records, non-destructive evaluation, etc	Sensor input analysis and fusion capability of ITSIP software; AI inference of results
Identify inconsistencies from previous known or reported status	Database of declared conditions and results of previous inspections
Identify unusual circumstances or behavior by inspected party that might indicate circumvention	Trend analysis of procedures used and measurements made in past inspections and comparison to present
Record and report inspection results quickly and accurately	Formatted database and inspection report for storage of inspection results
Manage large amounts of data	ITSIP hosted by powerful but compact system
Avoid inspector predictability	Trend analysis of past inspections
Know rights and responsibilities of all parties under the Treaty	START Treaty and Inspection Protocol archived in the system provides complete and instant access
Avoid preconceived explanations for inspection results	Circumvention scenarios remind inspectors of alternative explanations for observations
Minimize equipment needed from site to site	Portable, light weight system

However, since the initiation of the ITSIP Project, several circumstances have changed which have redefined the context within which ITSIP was developed:

- Uncertainties in the FSU have delayed START entry into force. Cooperative Threat Reduction (Nunn – Lugar) initiatives for the republics of the former Soviet Union are receiving increased attention, and former Secretary of Defense Aspin's "Four Dangers" have focused much of the defense community's thinking on the proliferation of nuclear, chemical, and biological weapons, particularly in the Third World.

- The International Atomic Energy Agency (IAEA) has gained "in-country" experience in Iraq, and has been frustrated in accomplishing on-site inspections in North Korea in accordance with North Korean obligations under the Nuclear Non-Proliferation Treaty. Further, the fear of chemical

warfare by Iraq against the Coalition partners and Israel in early 1991 brought home the reality of the concern for weapons of mass destruction. It is generally recognized that the IAEA will continue to play a critical role in verifying compliance with the NPT.

- ITSIP development revealed the shortcomings of START portal monitoring as an application environment for data and sensor fusion. START portal monitoring procedures are generally sequential or take the inspector down alternative paths; they provide few opportunities for sensor fusion. The treaty environment is not "sensor rich." Also, X-ray technology has fallen out of favor with the verification community, and the role of on-site sensors to support START verification is uncertain at best. Most importantly, the START inspection community has been unwilling to accept START as a convincing demonstration environment.

- The Open Skies Treaty and the Chemical Weapons Convention have been signed and will enter into force in the coming year or two. Both treaties have major roles for the interpretation of sensor data. Top-level illustrative ITSIP applications have been created for the purpose of showing how ITSIP could be tailored to contribute to verification of the Chemical Weapons Convention (CWC) and for International Atomic Energy Agency (IAEA) inspections of nuclear facilities. Demonstrations of these applications have evoked wide interest. They suggest the broad, multi-treaty applicability of the ITSIP approach.

1.3 THE WAY AHEAD.

ITSIP's developers believe that the ITSIP approach is valid in a multi-treaty environment – perhaps even critical. At least three potential application environments – CWC, NPT/CTR, and the Open Skies Treaty – have been suggested as promising. As noted above, exploratory work has already been done on the first two.

1.3.1 Chemical Weapons Convention (CWC).

The CWC's verification requirements will challenge the abilities of the anticipated 500 to 800 inspectors working for the Organization for the Prohibition of Chemical Weapons (OPCW) at the Hague when it becomes fully operational by early 1995. In addition to routine inspections of weapons and agent production and storage facilities that have been declared by states, inspections will also be required on other facilities in signatory countries throughout the world that produce various chemicals. Challenge inspections at undeclared facilities may be required to resolve ambiguities. Large quantities of data that these inspections will generate will put a premium on automated information systems that assist compilation, analysis, and reporting of inspection results. Several sensor technologies such as acoustic resonance and neutron activation are available to verify the form and contents of containers. This is a problem that is well suited to an ITSIP-type system.

Proposed Objective: Demonstrate the ability to fuse data from different Non-Destructive Evaluation (NDE) sensors with inspector input to verify stockage levels of chemical agents at storage locations to a required level of confidence.

1.3.2 Nuclear Non-Proliferation Treaty (NPT) and Cooperative Threat Reduction (CTR).

The concern for nuclear proliferation poses several challenges. International Atomic Energy Agency (IAEA) inspectors are responsible for verifying that nuclear materials are not diverted from peaceful uses to the production of weapons. This is done by routine, intrusive, sometimes frequent or continuous, inspection of declared facilities involved in the cycle of the production, use, and storage of declared nuclear materials. If, as the United States has proposed, a global ban on the production of weapons-grade materials (highly enriched uranium and plutonium) is enacted, inspection requirements, especially in the nuclear weapons countries, will increase markedly. Since the Iraqi nuclear program was uncovered, more attention has been paid to special inspections to detect clandestine development programs that may not be dependent upon the diversion of declared materials. The Cooperative Threat Reduction Program has put great emphasis on efforts to keep track of and assist in the dismantling of nuclear warheads and on the storage and demilitarization of nuclear material from the arsenal of the former Soviet Union.

As with CWC inspections, the quantities of data involved in nuclear inspections are large, and sensors can make important contributions. Unlike CWC, the tolerance for failure is small: 8 kilograms of plutonium may be enough to construct an explosive device. Illustrative ITSIP applications have been developed for routine inspections of declared uranium enrichment facilities and for special inspections of undeclared enrichment facilities. Also, inspections of breeder reactors and nuclear fuel reprocessing plants to ensure the non-diversion of nuclear materials would benefit from the use of an ITSIP-type system.

Proposed Objective: Demonstrate the ability to fuse sensor and inspector-entered data and compare results with library of known attributes of uranium enrichment facilities to determine the likelihood of clandestine enrichment of uranium to weapons-grade standards at an inspected facility.

1.3.3 Treaty on Open Skies.

The Open Skies Treaty is a extremely significant confidence and security building measure. It can also be an important verification adjunct to treaties such as the Conventional Forces in Europe (CFE) Treaty. Open Skies aircraft are permitted uninhibited access and, at full treaty implementation, will be equipped with a variety of commercially available sensors: video

cameras, panoramic and framing cameras, infrared line scanning systems, and synthetic aperture radar. The resolution obtainable from the use of these sensors as a function of their design specifications and flight profile is limited by treaty but still makes it possible to distinguish between major items of military equipment. Other sensors, such as air sampling devices, may be included in the future by mutual agreement of the parties. Open Skies inspection will be significant both for what is seen or not seen and the change this represents from past inspections.

A careful review of the Open Skies Treaty and United States preparations to implement it suggests that ITSIP may have a role after full treaty implementation. Because the agreed upon flight plan cannot be changed in flight except for safety reasons and because the sensors are relatively fixed in the aircraft, there is little value added presently for the type of in-flight analysis that, in other applications, permits an ITSIP-type system to optimize the utility of an inspection. However, these conditions could change, and it is important to anticipate the requirements that a more permissive environment could generate. Given a treaty regime (Open Skies II or a regional Open Skies) that permits some deviation from the planned flight route or the use of steerable sensors, the capability to do real-time processing of digital sensor data and sensor control would be very important to getting the most information from each flight. Under these circumstances, the utility of an ITSIP-type system is clear.

Proposed Objectives: Examine the feasibility of using an ITSIP variant in the Open Skies treaty area. Examples of possible investigation topics are:

- Region-Of-Interest Identification for Revisit or Sensor Focus. Investigate required data rates, interface electronics, and data rates for a portable Region-Of-Interest (ROI) identification system; and define the concept of operations of the system. A ROI identification system would analyze acquired data in near real-time, and identify regions of interest for further scrutiny to allow pointing and allocation of limited field-of-view sensors. Although such sensors are not presently used for Open Skies data collection, investigation of this capability would enable policy-makers to conduct informed discussion and negotiation regarding their use.

- Inspection Support for Foreign Open Skies Aircraft. The use of ITSIP as an "electronic guide" for inspectors performing time-limited inspections of foreign country Open Skies aircraft, to ensure that only authorized data would be collected at authorized resolution levels, would be examined. Circumvention Scenarios would be developed to describe techniques for concealing unauthorized sensors or increasing sensor resolution surreptitiously; and an inspection procedure would be developed to assist an inspector in determining that no such circumvention was occurring.

- Environmental Sensing. The use of ITSIP in acquiring and analyzing air samples for environmental monitoring would be examined to determine its feasibility and utility. Other types of airborne sensors useful for environmental monitoring would be considered as well.

1.4 IMPLEMENTATION STRATEGY.

Extending ITSIP into other application areas will require performing the following general tasks:

- Collect data on treaty-permitted sensors.
- Research the inspection environment and procedures and collect data on treaty limited items.
- Tailor the ITSIP system architecture to the particular problem or problems involved. Adjust Graphical User Interface functionality.
- Identify circumvention opportunities and analyze circumvention strategies that an adversary might use to cheat on the treaty. Develop detection approaches.
- Load data and develop rule base.
- Plan for and conduct system demonstration.

1.5 RECOMMENDATION.

Fully fund development of ITSIP CWC, NPT/CTR, and Open Skies applications to produce tabletop demonstrations similar to those that have been done for the ITSIP START application.

APPENDIX D

OPERATION OF THE ITSIP SOFTWARE

APPENDIX D

TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX D

OPERATION OF THE ITSIP SOFTWARE

1.1 INTRODUCTION.

The Innovative Treaty Sensor Integration Project (ITSIP) software was developed to demonstrate how graphical, user friendly software might be useful to treaty monitors or other arms control inspectors. It is designed to run on a notebook-size computer, permitting completely self-contained field operation. For extended periods of use in an office environment, it is sometimes desirable to use an external mouse, keyboard, and color monitor for increased comfort. (Consult the *Macintosh User's Guide for Macintosh PowerBook 160 and 180 computers*, published by Apple, for details on how to connect these items.)

The ITSIP software provides selections for three treaty environments. The functionality of these treaty areas varies from that of limited illustrative diagrams that allow a few user selections, to the full function of the START Treaty, in which numerous user selections can be made and numerous system responses may result.

The software is designed to be user-friendly. It is not necessary to learn obscure operating system commands to run the system. In fact, the system can practically be run on a trial-and-error basis, with no training at all. Nevertheless, it is recommended that the user review the short intro- duction to the system below in order to take advantage of all system features in the most expedient manner. The introduction will explain the underlying character of the ITSIP user interface.

The ITSIP software was developed primarily to illustrate the value and utility of the system rather than a fully deployable and fully operationally tested system. As a consequence, some of its features may produce results that seem contrary to intuition. The following guide explains these features so that the user may either avoid them or "cancel" the effects of unexpected operations.

1.2 STARTING THE SOFTWARE AND PUSHING BUTTONS.

The software is started by (rapidly) double-clicking on the icon labeled "ITSIP Multi-Treaty." The icon is illustrated in Figure D-1 (If you cannot see the icon, try closing some windows on the computer screen.) After the icon is double-clicked, the computer screen will display the window shown in Figure D-2, ITSIP Treaty Selection. Note the four titles, each one placed above a square "button" on the computer screen. These buttons are the primary means for

Figure D-1. ITSIP multi-treaty.

operating ITSIP, especially in computer screens showing flowcharts. As the cursor is moved within this panel, it becomes a hand with an outstretched index finger, signifying that it is ready to "push" a button. If the cursor is moved off this window, it changes into an arrow.

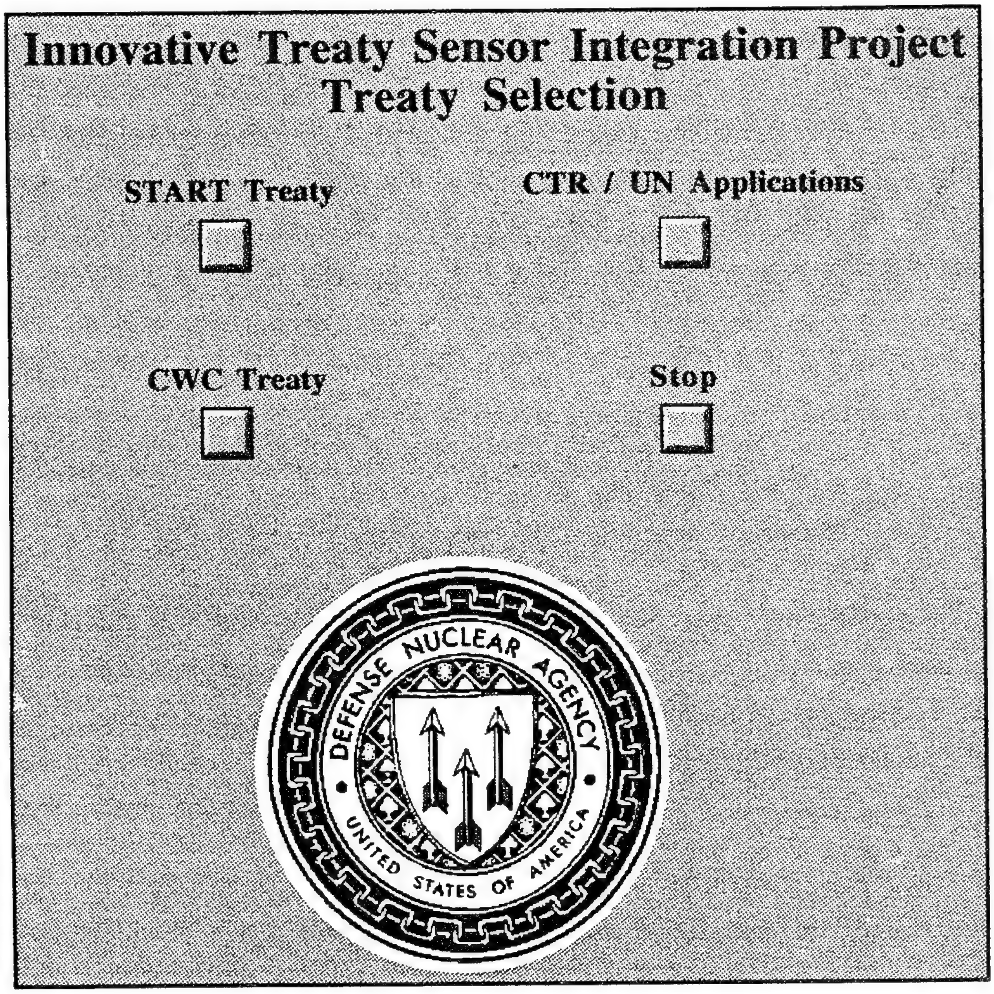


Figure D-2. ITSIP treaty selection.

One of the three treaty areas can be selected by moving the cursor so that the index finger is positioned on the corresponding button, and then clicking the mouse or computer mouse-click pad. The **START Treaty** button provides a good example for exploring the software. Press the button once firmly and then release it. Notice that as soon as the button is depressed, the button pressed briefly changes color, becoming darker, and then changes back to its original color. This shows that the button has been activated.

As soon as the **START Treaty** button is depressed, a new window appears. The window is shown in Figure D-3, ITSIP START Portal Inspection. *(Technical note: the previous window is still active in the background, and has simply called the presently visible window as a*

subroutine.) Now there are three different buttons to choose from. For a quick preview of the controls and symbols you'll encounter in the program, select the **View Legend** button.

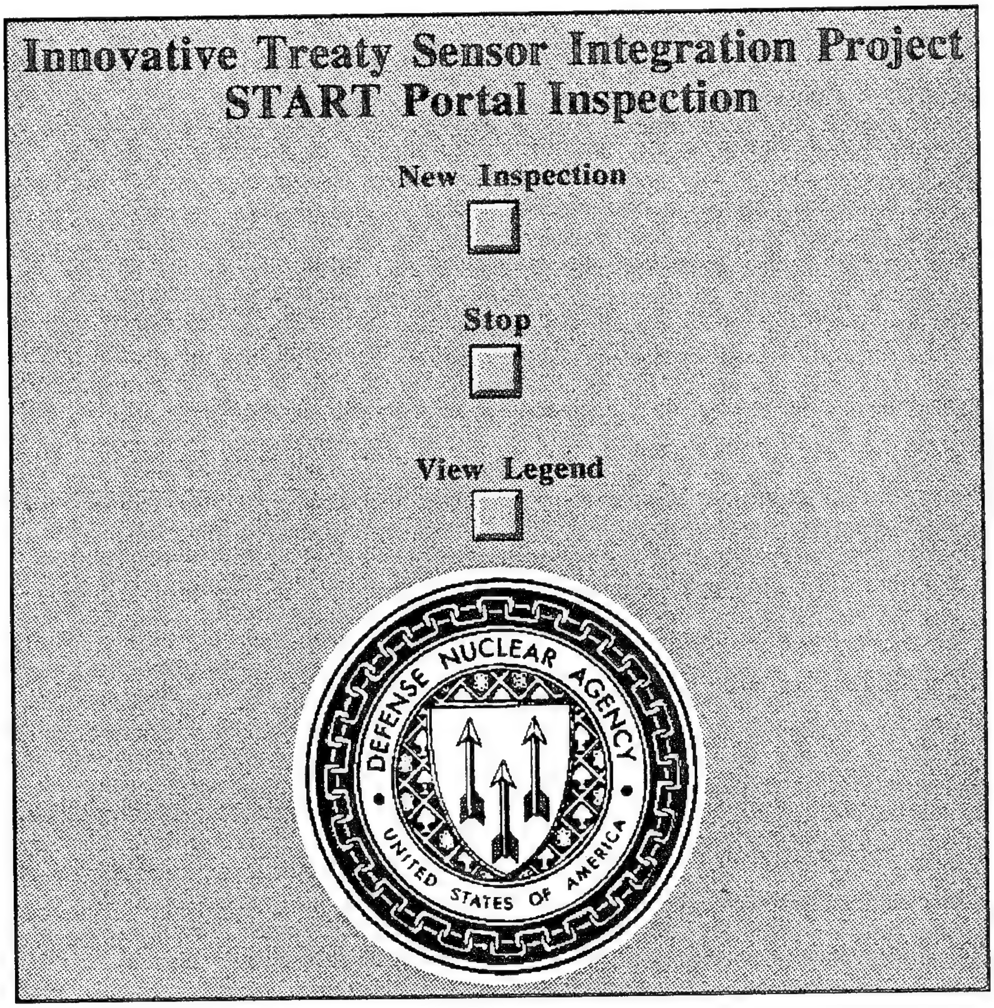


Figure D-3. ITSIP START portal inspection.

1.3 FLOWCHARTS, ICONS, AND CONTROLS.

If you've followed the steps outlined above, you will see the chart reproduced in Figure D-4, IP Flowchart Legend. This chart, called the **IP FLOWCHART LEGEND** (IP for Inspection Protocol), shows examples of shapes (called *icons*), buttons, switches, and other nomenclature that you'll encounter in the **START Treaty** *flowcharts*. The flowcharts show the sequential stages to performing the inspection, including arrows to direct the inspection to certain procedures under certain conditions. If an external color monitor is used (or if the software is rehosted on a Powerbook with a color screen), some of the shapes will appear blue and others, green. In monochrome the "green" icons are slightly darker than the "blue" ones. The blue icons indicate questions or inspection steps that have not been encountered yet in progression

through the flowchart. Those that have been completed, or which mark the current "place" in the inspection flowchart, are colored green. As a user progresses through the flowchart, the icons that have been used change in color from blue to green.

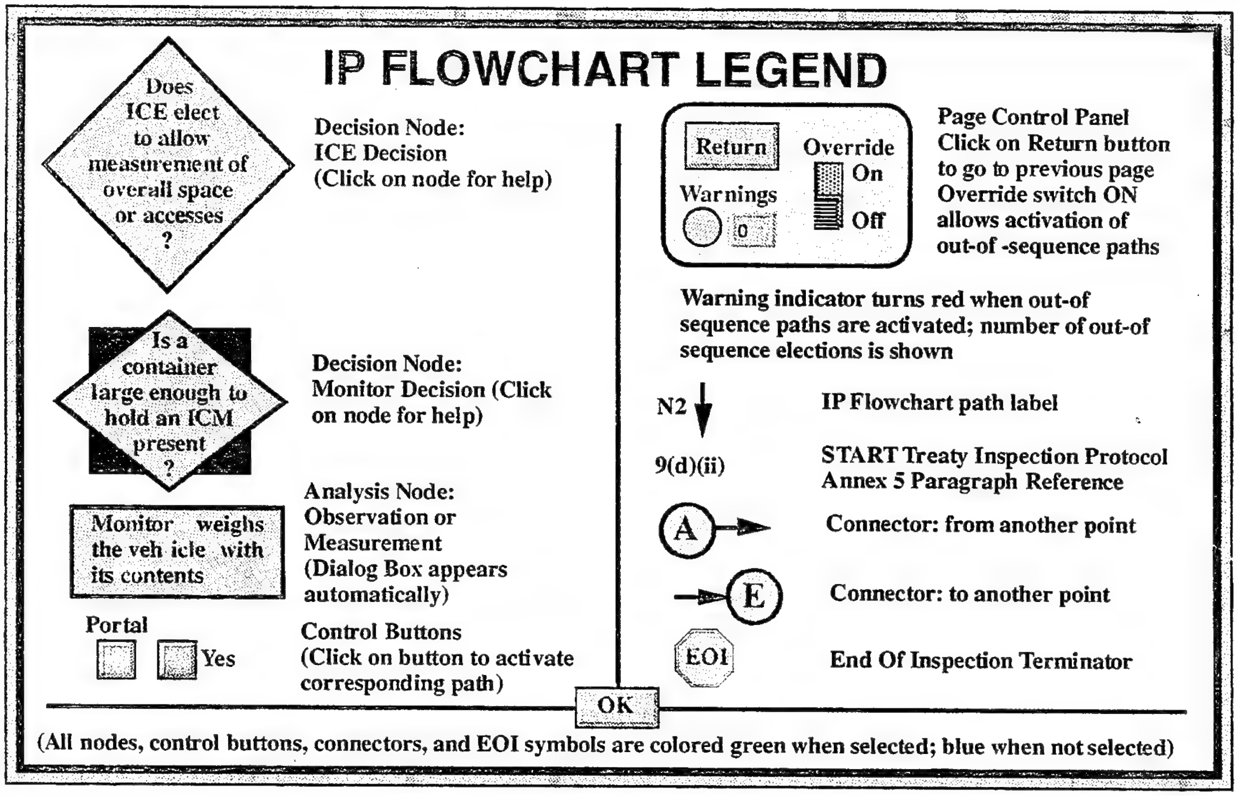


Figure D-4. IP flowchart legend

The first two icons in the legend are diagonal in shape. These icons, named *decision nodes*, contain questions with more than one possible outcome. The second icon is overlaid on a black rectangle. This symbol indicates that the particular decision present will be made by the *treaty monitor*. If there is no black rectangle under the diamond, the decision will be made by the *In-Country Escort* (ICE).

The third icon has a rectangular shape and the text it contains describes a procedure. This icon is called an *analysis node*. The procedures contained in Analysis nodes are either measurements, such as weighing a vehicle, or observations, such as viewing the interior of a railcar. Since these procedures usually result in data being collected, the analysis node has provisions for recording this data and viewing the results.

If the IP Flowchart Legend is being viewed on a Powerbook 180, the bottom items that can be seen are two buttons, labeled Portal and Yes. (These buttons are illustrations only and are not operable.) However, there is more to be seen on the Flowchart. This is done by moving the

scroll bar at the left side of the window. The scroll bar looks like a small square in a long vertical gray space. Move it by clicking once (press-release) above or below the bar or by dragging the bar up or down in the vertical space. If these instructions seem confusing, additional explanation regarding scroll bars can be found in the *Macintosh User's Guide*.

On the top right of the IP FLOWCHART LEGEND is a rectangle with rounded corners, known as the *Control Panel.* The control panel has a **Return** button that will return the user to the preceding window, a **Warnings** indicator and an **Override** Switch. The latter two items are concerned with the proper sequence in which the user is expected to press buttons to move through the flowchart. Certain buttons must be pushed before certain other buttons, and certain combinations of buttons are not expected to be pressed at the same time. If the user attempts to select buttons out of sequence or is in an unexpected combination, such as answering a question with both **Yes** and **No**, the buttons will "refuse" to depress to warn the user. If the user wants to select the button anyway, the **Override** switch can be turned on and the button in question can then be pushed regardless of sequence or combination. In this case the **Warnings** indicator will change to red to warn the user that the unusual condition exists, and the number of such conditions present will be recorded in the adjacent numerical display.

The alphanumeric "codes" displayed in the **IP FLOWCHART LEGEND** below the **Control Panel** that contain uppercase letters will appear adjacent to arrows (or *paths*) in the flowchart. These provide a reference nomenclature used by the ITSIP software to tell the user things about certain paths. On the other hand, the alphanumeric codes with lowercase letters refer to specific paragraphs of the START Treaty Inspection Protocol for Continuous Monitoring (Annex 5). These codes indicate that a certain procedure is prescribed by the named paragraph in the START Treaty Annex, and provide the user with supporting justification for performing the procedure in case it should be desired.

The large single letters enclosed in colored circles are *connectors*, showing that the procedure is picking up from a previous window of the flowchart (at a point indicated by a circle containing the same letter) when the arrow is leaving the circle. If the arrow is pointing into the circle, it indicates that the procedure will be continued in another window at a point indicated by a circle containing the same letter. The circles will change in color from blue to green when they are activated.

The final icon shown in the **IP FLOWCHART LEGEND** is a "stop sign" shape containing the letters **EOI** for End Of Inspection. This icon illustrates that a certain path will close the

inspection. If the path leading to the **EOI** is activated, the **EOI** changes from blue to green, indicating that the inspection has ended.

When you have concluded your inspection of the icons shown on the **IP FLOWCHART LEGEND** press the OK button at the bottom center of the **IP FLOWCHART LEGEND** to exit the window. The screen will again display the START Portal Inspection Main Window.

1.4 NAVIGATING THE FLOWCHART.

The START Treaty inspection program is initiated by pressing on the **New Inspection** button once. After this button is pressed, a wrist-watch icon will appear, indicating that the software is loading. It will take about 45 seconds for all initialization to occur.

When the inspection software has started, *Page A* of the flowchart will appear as illustrated in Figure D-5, Flowchart Page A: Continuous Monitoring. Notice the title for Page A in the upper right. The software starts with two of the icons already colored green. The lower of these two is the "current" point of progress. The diagonal without a dark square background indicates an ICE decision. Pressing on one of the buttons will cause the succeeding icon to illuminate. Press on the button labeled **Portal** to indicate that the vehicle is departing from a portal exit. (*Note that all buttons have their own unique alphanumeric code, P1 in this case.)* The next icon in line *(as indicated by the arrow from the P1 button)* has turned green. Recall that a Help window is available under this decision node icon, and can be viewed by pressing once on the icon, near the center. Press on the icon to view the contents of the Help window.

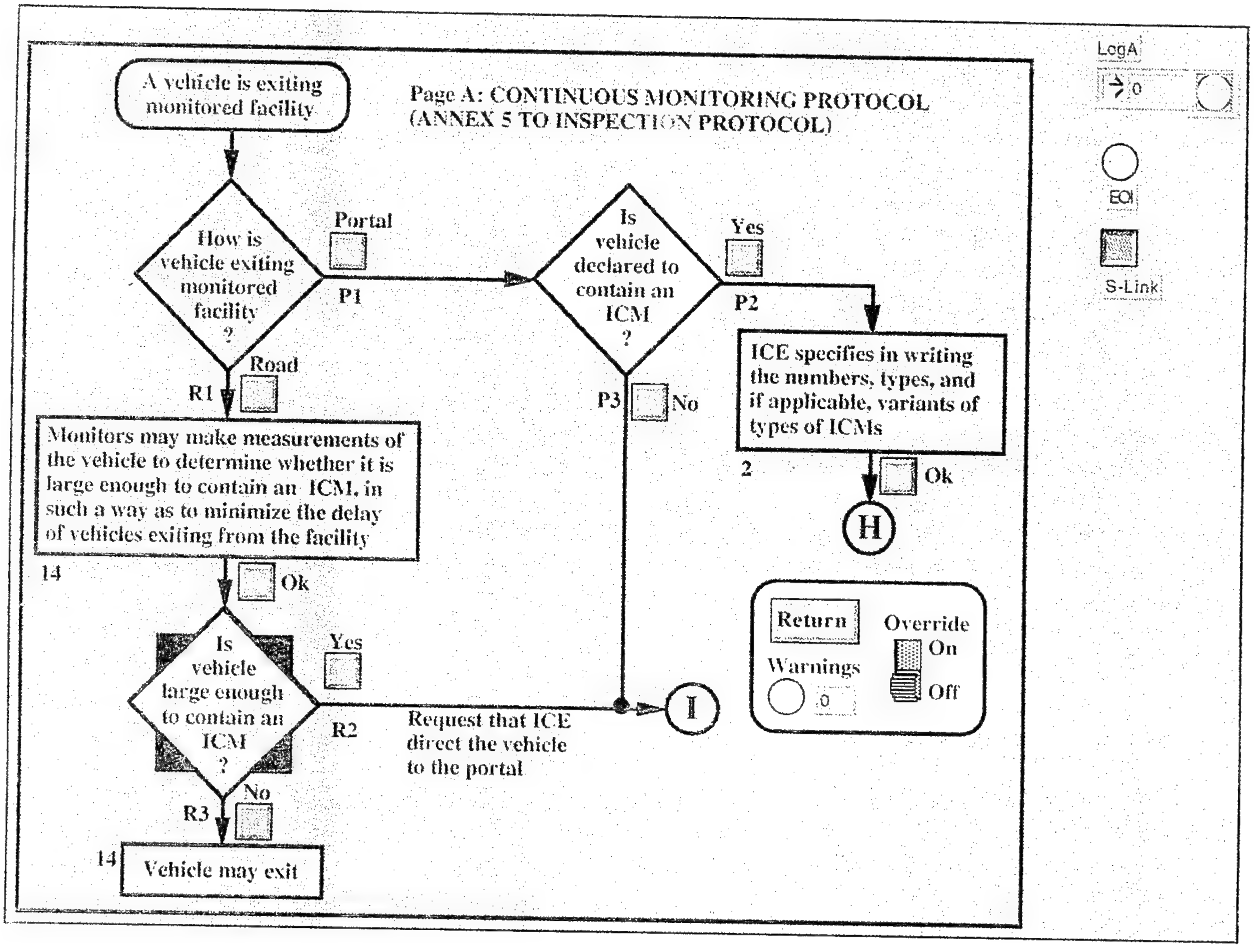


Figure D-5. Flowchart page A: continuous monitoring.

1.5 USING THE HELP WINDOW.

The Help window appears as shown in Figure D-6, Help Window: Show All TLIs. The scroll boxes and buttons in the Help window are operated like similar scroll boxes and buttons in the dialog boxes, which will be explained in the subsequent sections. Note the button labeled **Show all TLIs**. This button, present in some of the Help Boxes, changes the contents of the scroll box in the center of the top section of the Help Box. At first, the box **shows Remaining ICMs/ ICM 1st Stages**, but after the button is depressed, the scroll box will show **All TLIs** (Figure D-6a, Help Window: Show ICMs Remaining). Pressing the button again will change the scroll box contents back to **Remaining ICMs/ICM First Stages** again. Operation of the scroll boxes and the meaning of TLIs and ICMs is explained in a later section under Dialog Boxes. The help window is "dismissed" by pressing on the **OK** button, and operation of the flowchart may be resumed.

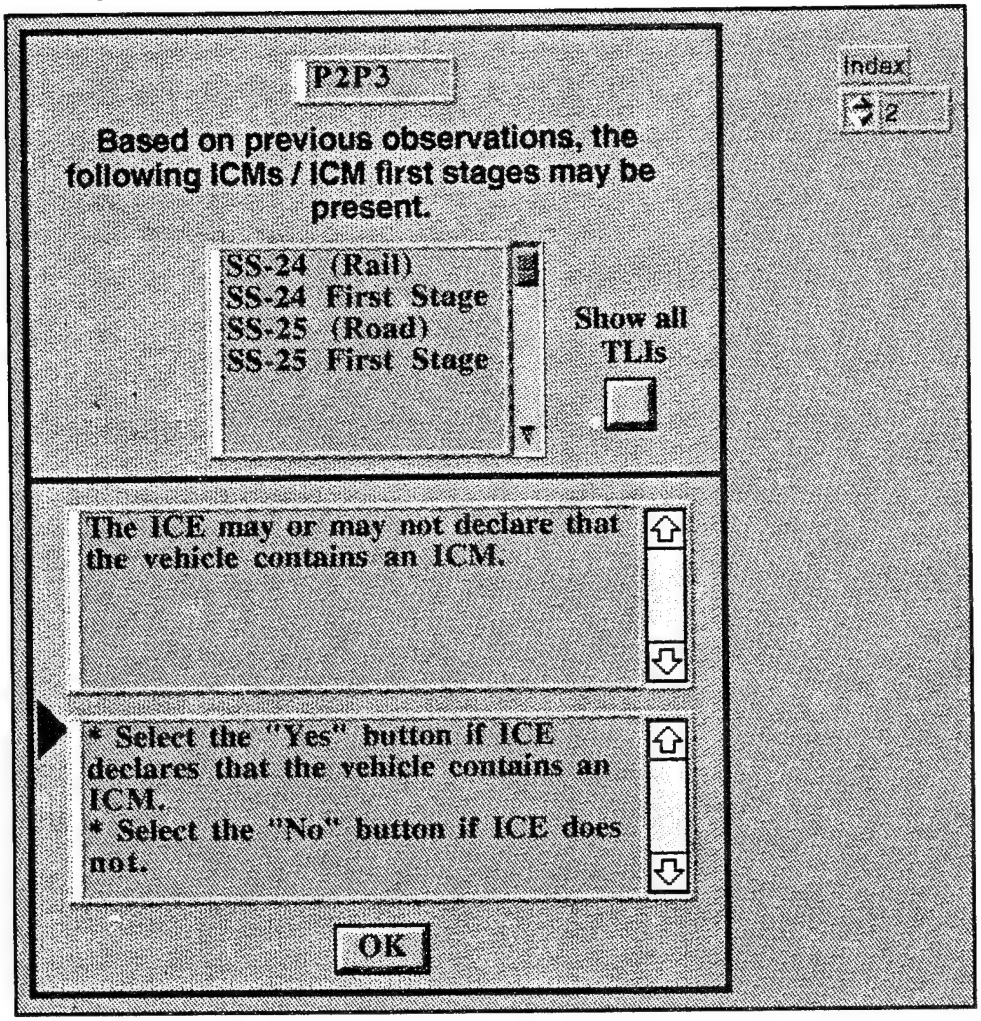


Figure D-6. Help window: show all TLIs.

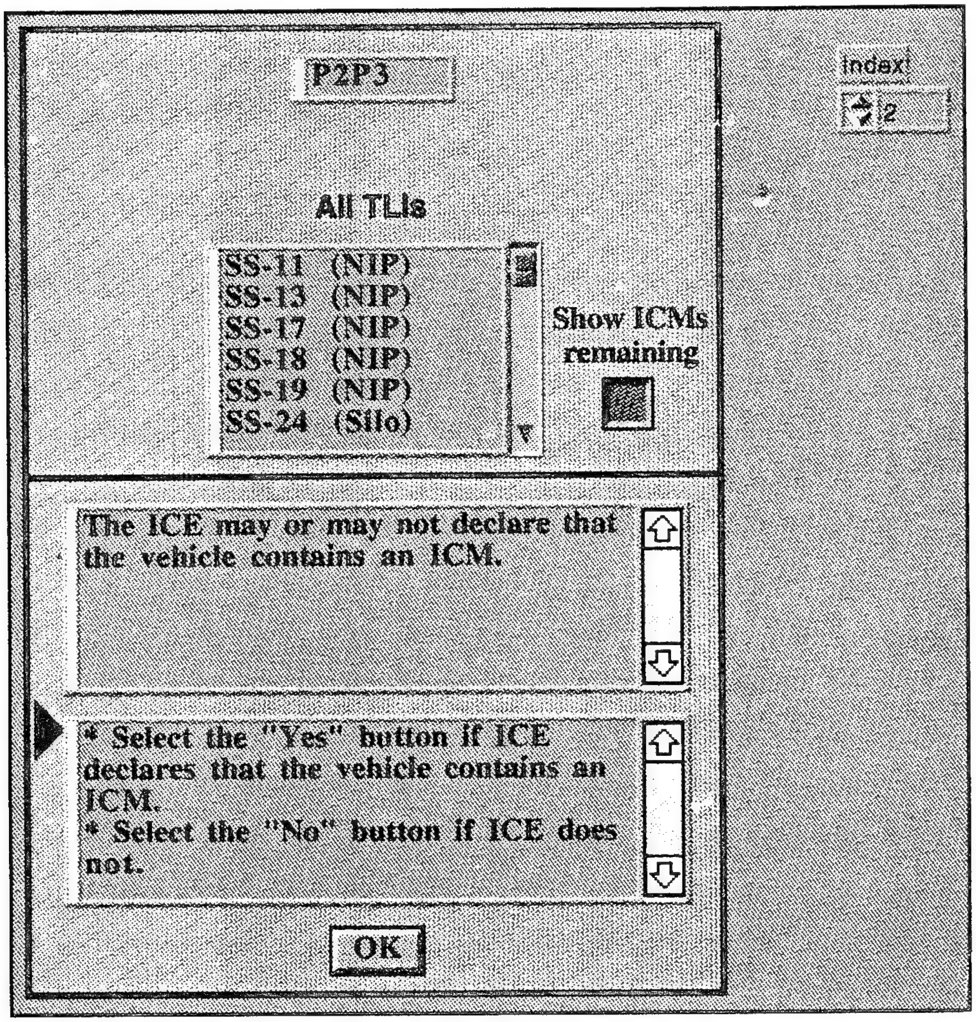


Figure D-6a. Help window: show ICMs remaining.

1.6 MORE FLOWCHART NAVIGATION.

Note that the flowchart proceeds to a connector labeled **I**. As the **P3** button is pressed, the **I** connector will turn green and then the page of the flowchart at which **I** reconnects will automatically appear. This happens to be Page C. The program has “skipped” Page B, because the procedure of the flowchart led directly from Page A to Page C in this case. *(Other buttons on Page A, if selected, would have led to Page B.)* Pages B through F of the flowchart are shown in Figures D-7 through D-11, Flowchart. Now, if it is desired to return to the previous page, this can be done by pressing on the Return button on the control panel of the present page. If the control panel is not in sight, it will appear if you scroll down the page. Back on Page A, the **I** connector is still green. Pressing on the **P3** button will back up our progress on the flowchart to where we were before automatically switching to Page C. *(Technical note: whenever the Return button on a page is used to back up to a previous page, jumping back to that page again will*

require clicking on the connector node; this is to say that a connector node operates "automatically" only the first time it is "used.")

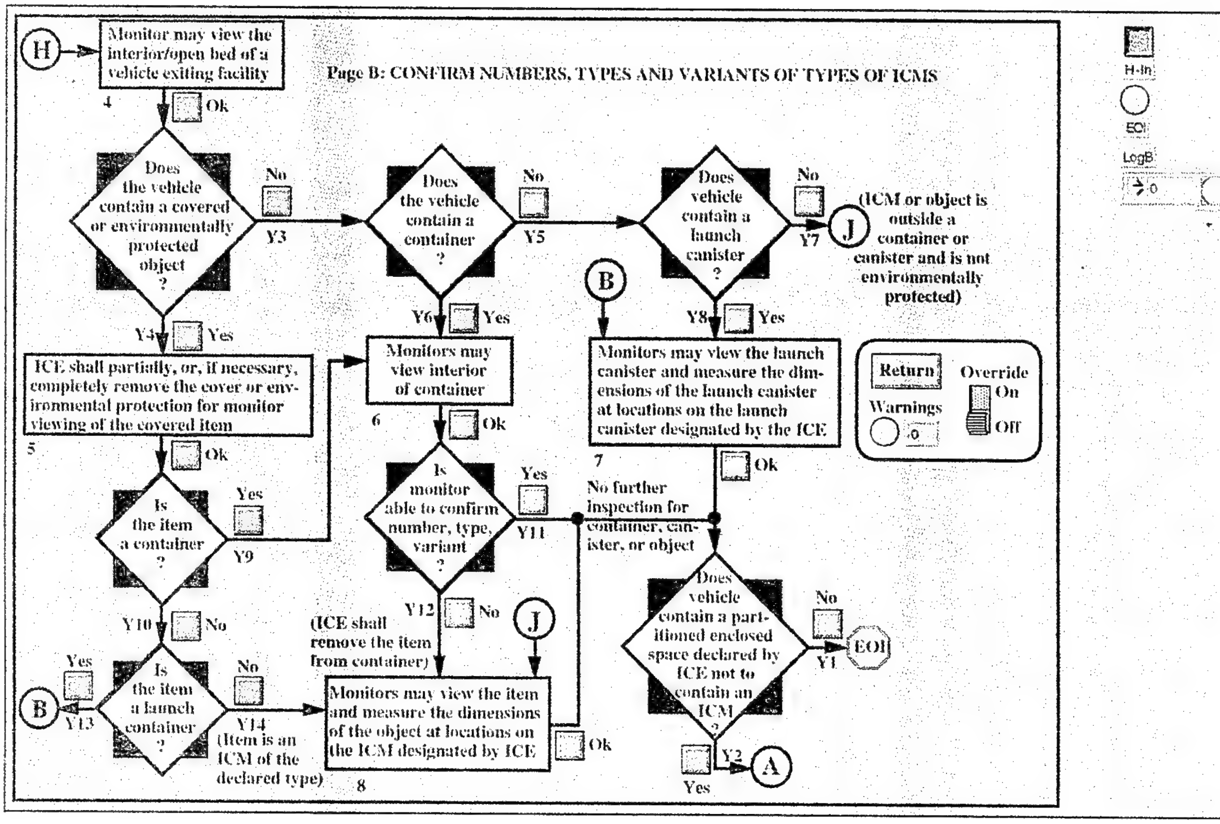


Figure D-7. Flowchart page B: confirm numbers, types and variants of types of ICMs.

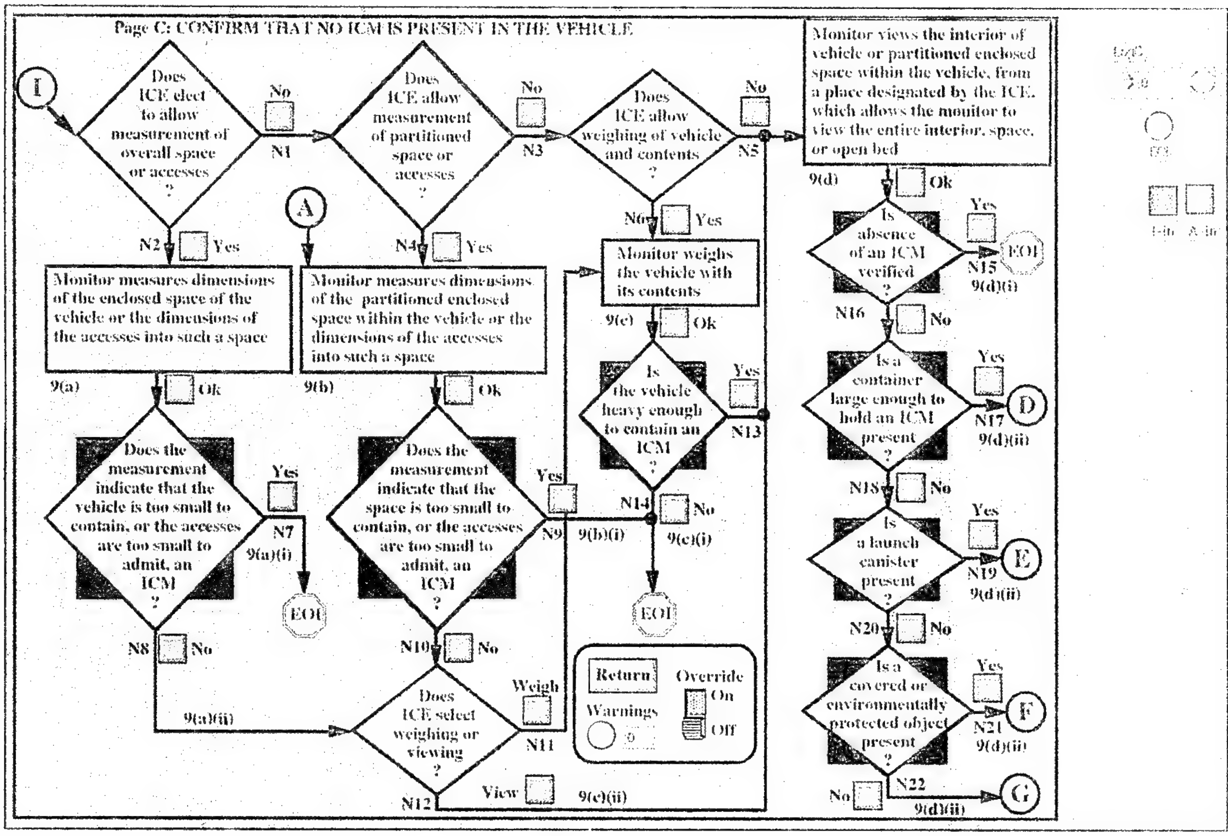


Figure D-8. Flowchart page C: confirm that no ICM is present in the vehicle.

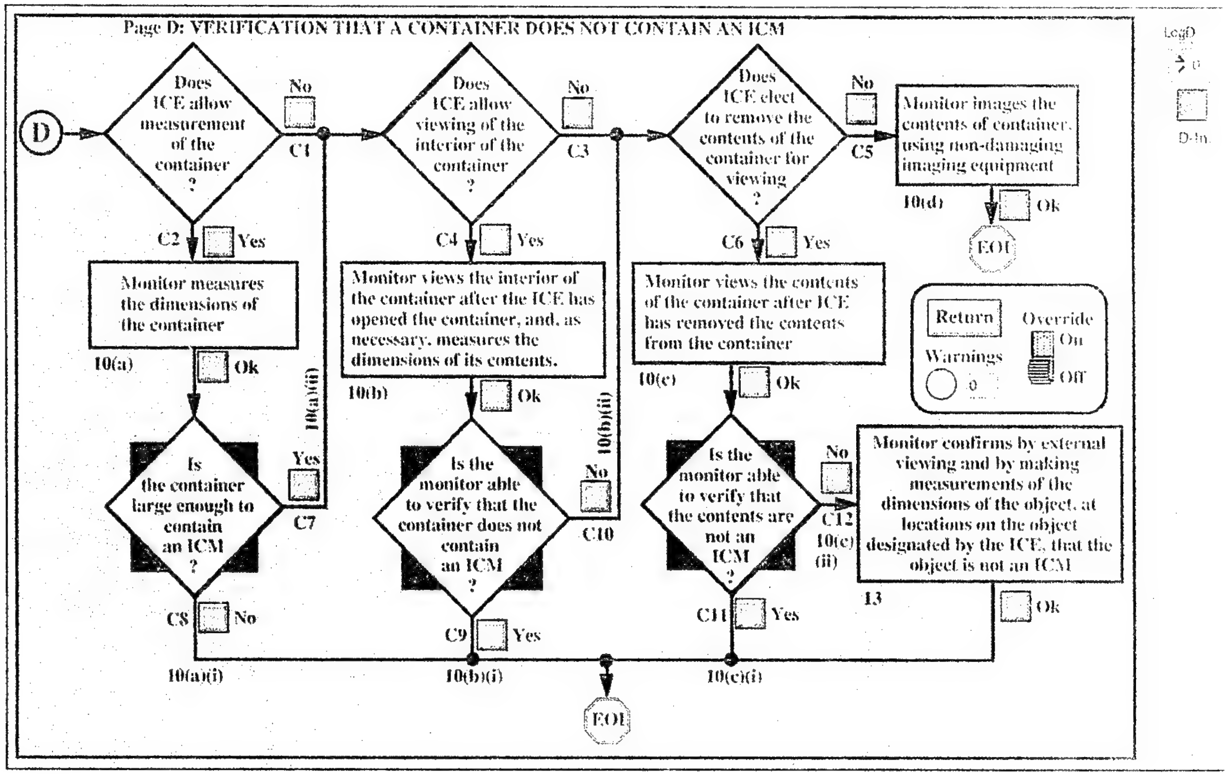


Figure D-9. Flowchart page D: verification that a container does not contain an ICM

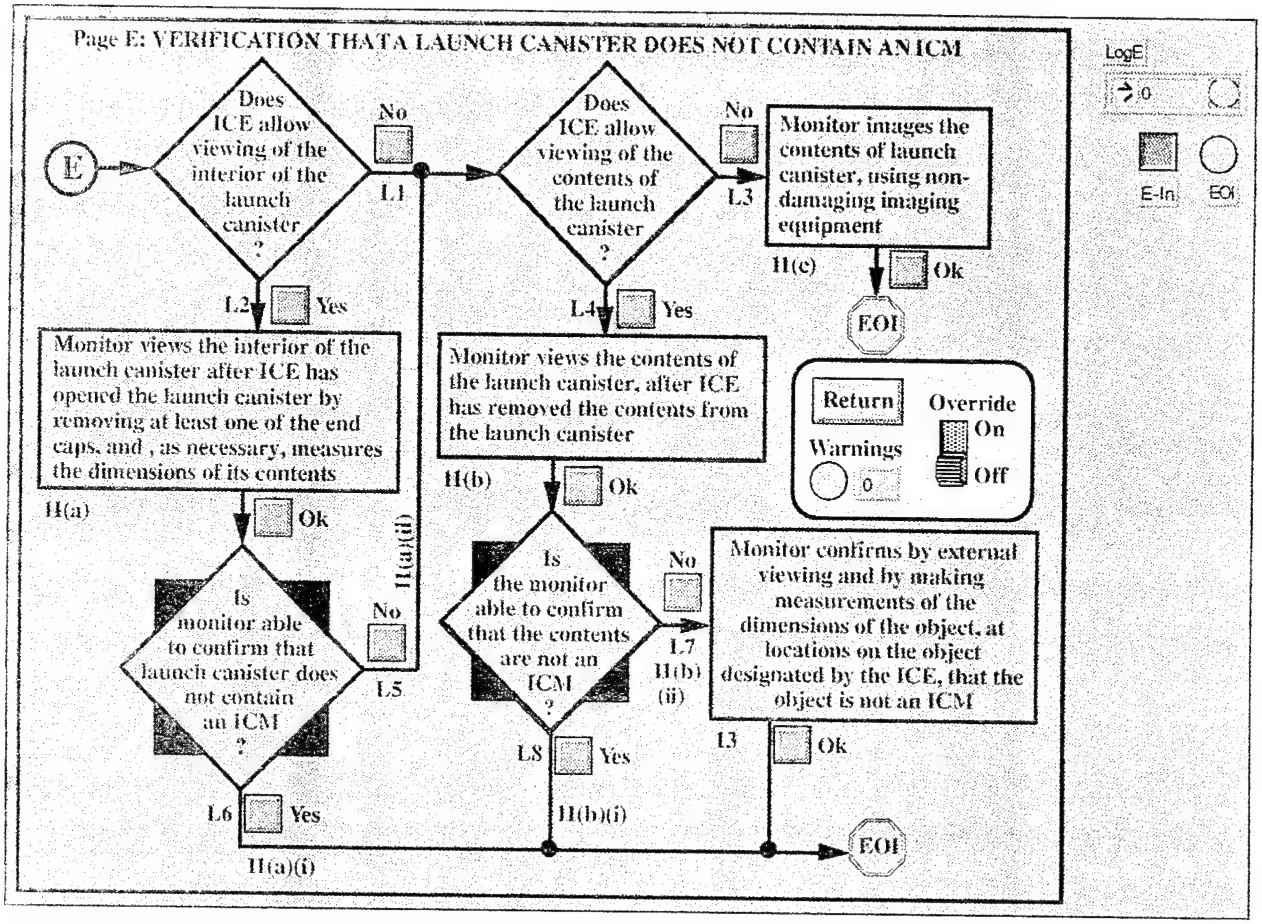


Figure D-10. Flowchart page E: verification that a launch canister does not contain and ICM.

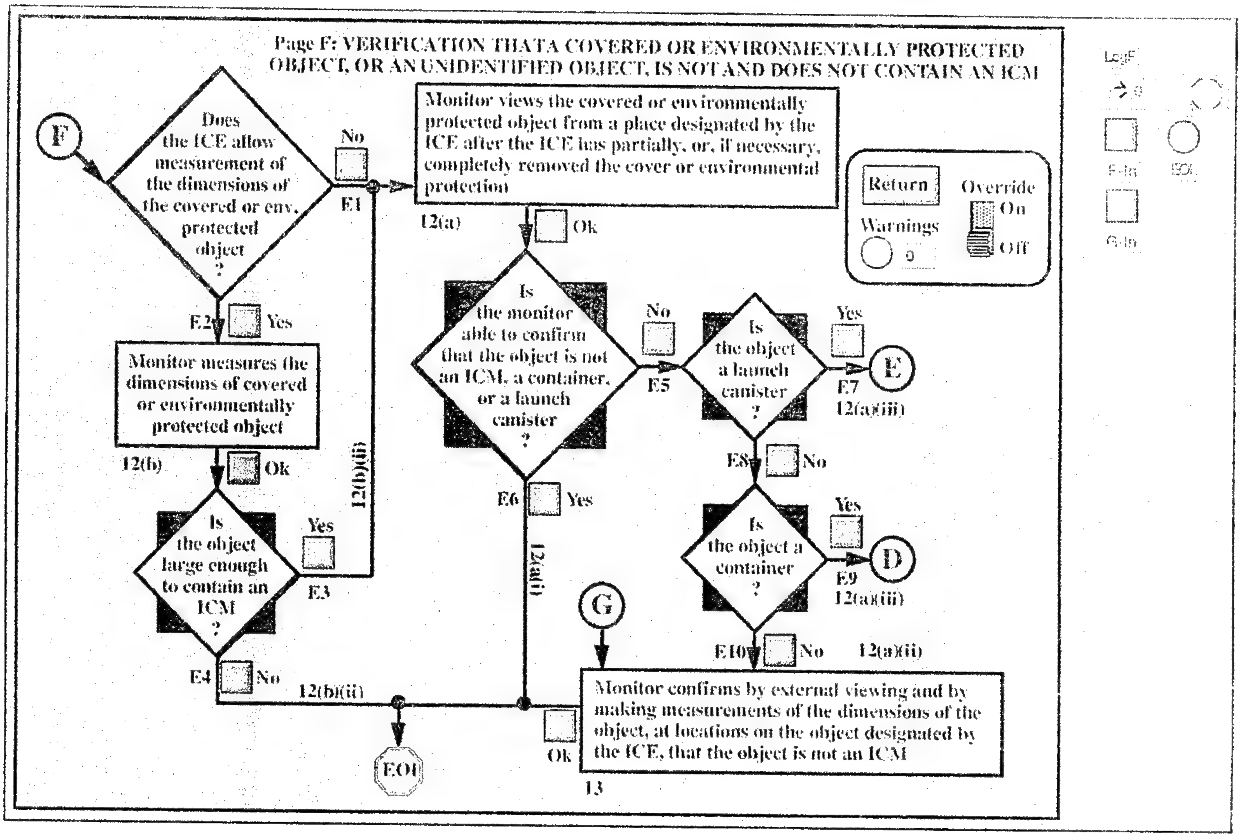


Figure D-11. Flowchart page F: verification that a covered or environmentally protected object, or an unidentified object, is not and does not contain and ICM.

Now let's return to Page C to continue the inspection. Press button **P3** and then click once on the I connector. Scroll upwards in Page C, using the scroll bar, until the last green icon is located. Now we'll invoke an *analysis node*. This can be done by clicking once on the **N2** button, indicating, as stated in the ICE decision node, that *"measurement of overall space or accesses"* is allowed by the ICE. The analysis box, indicated by the nomenclature *9(a)* at its lower left, will turn green and will then automatically open up a *dialog box* titled **Enclosed Space or Access Measurement,** as shown in Figure D-12. The box opens automatically because measurements or observations are always made in analysis nodes and the results of these measurements or observations will be entered into ITSIP. Note that the flowchart is still there, under the dialog box, but that the dialog box is the "current" panel as indicated by the horizontal "pinstripes" in its window title.

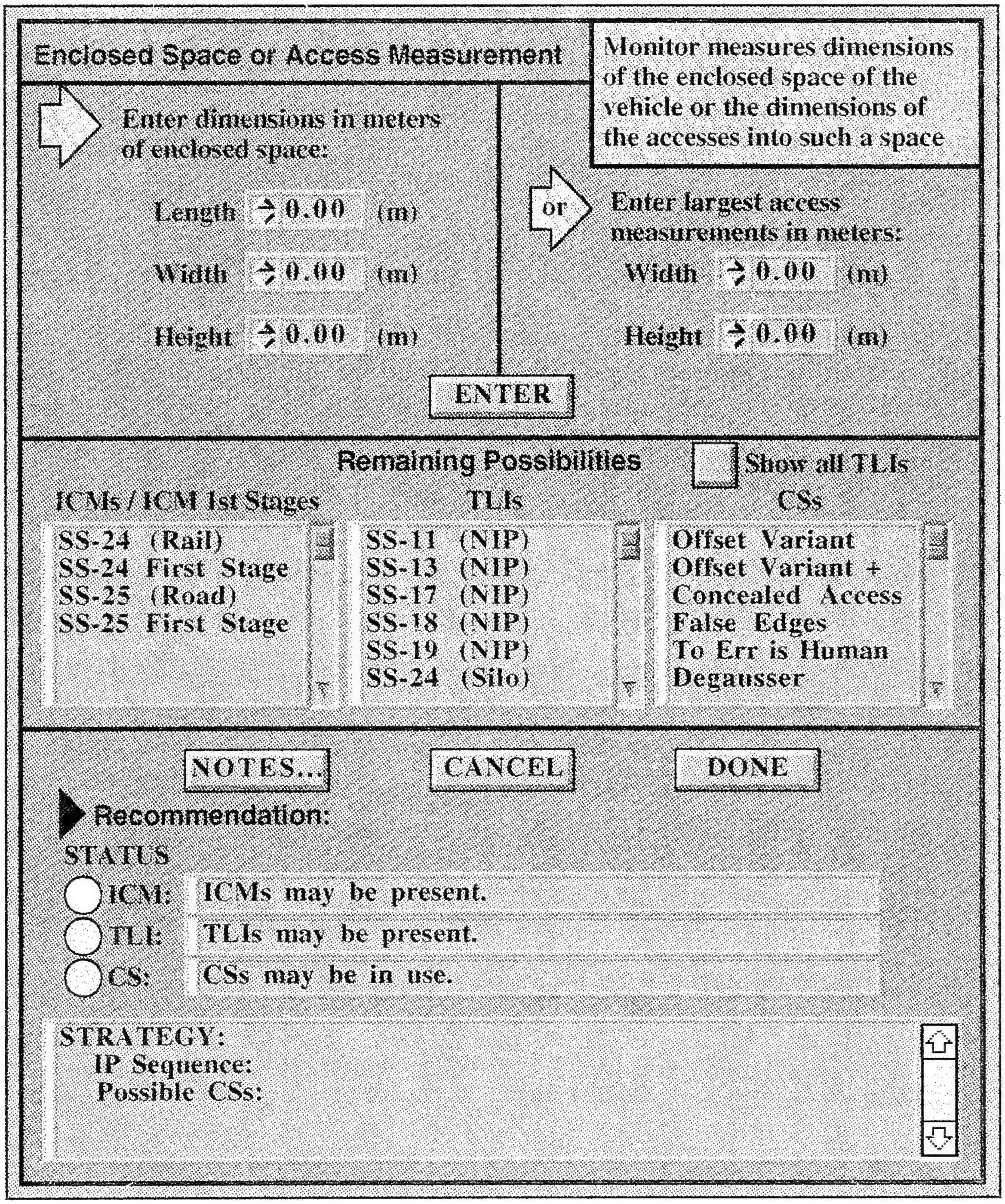


Figure D-12. Enclosed space and access measurement.

1.7 FEATURES OF THE DIALOG BOX.

This is a good time to examine the contents of a dialog box. The START Treaty inspection software contains more than twenty of them, all quite similar. Each dialog box has a unique alphanumerical designator of one of the paths leading into it (sometimes there are more than one

path), followed by a period, followed by a number and possibly a letter displayed near the corresponding analysis box on the flowchart, usually at the lower left. For example, the dialog box that we have just opened is referred to as **N2.9(a).** *The nomenclature 9(a) refers to a particular paragraph of the "START Treaty Inspection Protocol for Continuous Monitoring" (Annex 5) corresponding to the measurement or observation described in the analysis node.* Notice that the analysis node that opened the dialog box is duplicated at the top right of the dialog box, for reference by the user. Below the dialog box title and the duplicated analysis node icon is the *data entry area* of the dialog box. This area varies slightly from one dialog box to another because the types of data being entered are different. In this case the data consists of dimensional measurements of enclosed space or of accesses to a vehicle.

Below the data entry area is the **Remaining Possibilities** area composed of three individual scroll boxes. These scroll boxes show two lists of items that may be present in the railcar based on data entered so far (Items of Continuous Monitoring (**ICMs**), Treaty Limited Items (**TLIs**), and one list of Circumvention Scenarios (**CSs**)) which, based on available data, are possibly in effect.

Scroll down to the third area. This area contains three buttons for controlling the action of the dialog box and its treatment of any data entered. It also contains the **Recommendation** section. This is where the program offers helpful hints to the treaty monitor. The **Recommendation** section has a **STATUS** area containing three status lights (red, yellow, green) corresponding to the categories in the three scroll boxes in the **Remaining Possibilities** section (**ICM**, **TLI**, and **CS**.) Adjacent to each status light is a one-line message display area where the meaning of the status lights is explained. These lights and messages are for viewing only; their contents are not under direct operator control.

Below the **STATUS** area is a **STRATEGY** area with space for longer verbal messages. Notice the scroll bar on the right-hand side of the **STRATEGY** area. It is used for reading messages that exceed the size of the **STRATEGY** "window." The **STRATEGY** window will contain information of two types: an **IP Sequence** that proposes future decisions for the treaty monitor during the inspection, and the **Possible CSs** items that will warn the treaty monitor that certain Circumvention Scenarios are particularly suspect. At this point in the inspection, both items will be blank.

1.8 ENTERING DATA IN THE DIALOG BOXES.

Now that we have examined the elements of the dialog box, let's see how they work. Return the dialog box window to the data entry area at the top by using the scroll bar. Now, let's imagine

that we are entering the dimensions of an *access* into a vehicle. As the dialog box explains, these measurements belong on the right hand side. There is a space for a **Width** measurement and a **Height** measurement, both in meters (**m**). Both of these measurements read **0.00**, indicating that no measurement has been entered. We can enter data in three ways. The best way is to double-click (rapidly) in the middle of the numerical field. Try this for the **Width** field. The entire field will be highlighted in black, and the measurement can be typed in. Let's say that we have a door 1.2 meters wide. After typing in 1.2, notice that the cursor has changed to an "*I-beam*" in the numerical entry field. Using the mouse, move the cursor to the **ENTER** button (it will change to the "index finger" and press **ENTER**. Some changes will occur in the dialog box...back to this later. The second way to enter data is to click the mouse once in the numerical field and to use the cursor to modify one character of the number at a time. The third way is to move the cursor to the up and down arrows to the left of the numerical field and click on the arrows. Notice that the number will be incremented (by the up arrow) or decremented (by the down arrow) once for each click. After changing the number, be sure to press **ENTER** again.

1.9 READING THE SCROLL BOXES AND INFORMATION PANELS.

The contents of the scroll boxes in the Remaining Possibilities area have changed as a result of the number entered. (If you want to verify that this is true, enter a "0.0" in the **Width** box of the data entry area, click on the **ENTER** button, inspect the contents of the **ICMs/ICM 1st Stages** scroll box and the **TLIs** scroll box, then re-enter the "1.2" in the **Width** box, click on **ENTER**, and re-inspect the contents of these two scroll boxes.)

For each item in each of the three scroll boxes, additional information can be obtained by pressing once on the item. Try this for the first item in the **ICMs/ICM 1st Stages** scroll box by clicking once on the letters **SS-24 (Rail).** A new window appears on top of the dialog box, showing a drawing of the **SS-24** and some parameters. When you have finished looking at the information, dismiss the **SS-24 Panel** by pressing on the **OK** button near the bottom center. If the **OK** button is not visible, you may need to scroll down to the bottom of the panel, using the scroll bar. The **SS-24 Panel** disappears and the dialog box is shown again. An *information panel* can be displayed for every item in each of the three **Remaining Possibilities** scroll boxes.

The items in the **CSs** scroll box are slightly different in that they each have two information panels -- one **P** (Picture) panel and one **D** (Details) panel. Click once on the **False Edges** CS. The **False Edges P Panel** appears. It has a **Details...** and an **OK** button. Pressing the **OK** button will dismiss the picture panel, returning the program to the dialog box. Pressing the **Details...** button will bring up the **False Edges D Panel** containing the *TSAM* template for the False Edges

CS. For more information about the meaning and significance of the circumvention scenarios, the pictures, and the TSAMs template, consult the ITSIP in-process project briefings. To dismiss the **False Edges D Panel**, click once on the **OK** button near the bottom center of the panel, scrolling downwards if necessary. Note that the **False Edges P Panel** remains on the screen. To return to the dialog box, press the **OK** button near the bottom center of the screen.

Notice that the CSs scroll box is entirely full of CSs. In fact, there are *more* CSs beyond the scroll box. To see them, move the scroll bar at the right side of the scroll box by clicking once below the bar. Notice that new CS names appear.

There is one more feature of the **Remaining Possibilities** area that we haven't explained yet. This is the **Show All TLIs** button in the upper right of the **Remaining Possibilities** area. This button was devised because even though some of the TLIs in the scroll box might be ruled out, the treaty monitor might still want to see their names and call up their information panels. The **Show All TLIs** button, when pressed, will cause all the TLIs to be displayed in the **TLIs** scroll box, rather than just the ones that may still be present in the vehicle. Try it and see! If you want to see only the "remaining possible" TLIs, just press the button again.

1.10 READING THE RECOMMENDATIONS.

Let's look at the **Recommendation** area. In the **STATUS** area, the **ICM** light is red and the **TLI** and **CS** lights are yellow. Note the wording of the status messages adjacent to the three indicators. Now look at the **STRATEGY** area. No recommendations are offered, either for **IP Sequence** or for **Possible CSs**. To see these recommendations change, we will enter a new number, representing a smaller width of 1.0 m, in the **Width** area of the access measurement section (right hand side) of the data entry area. Remember to press the **ENTER** button after entering the number, and then inspect the **Recommendation** area. The N2.9(a) dialog box is shown in its status after these numbers have been entered in Figure D-13, Reading the Recommendations. Notice that the **STATUS** lights have all changed. The **ICM** and **TLI** lights have changed to green, and the status messages indicate that no ICM, and no TLIs, are apparently present on the basis of the measurements. This is consistent with the contents of the **ICMs/ICM 1st Stages** scroll box and the **TLIs** scroll box. However, the **CS** status light has changed to red, and the corresponding status message warns that a particular CS may be in use.

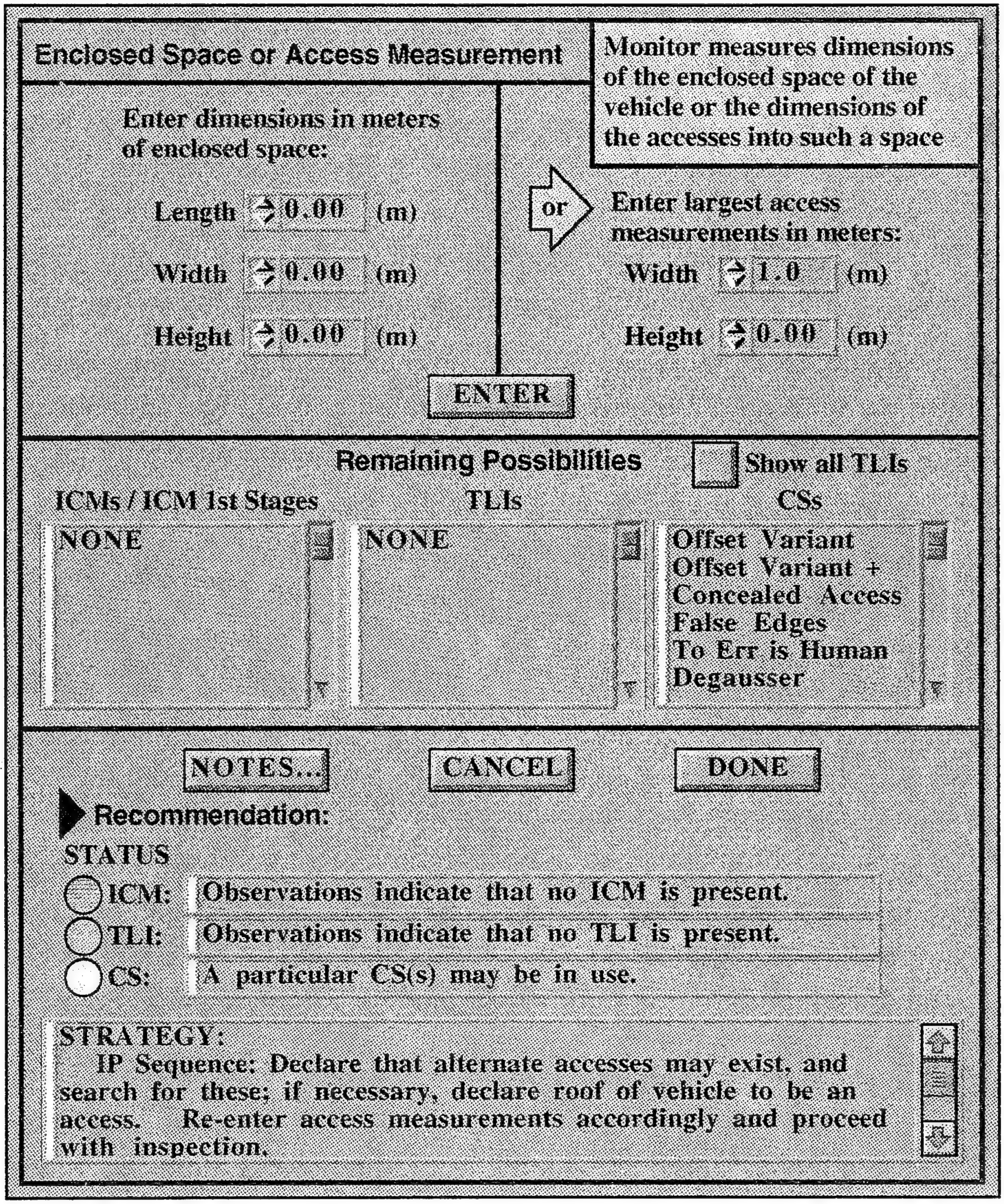


Figure D-13. Reading the recommendations.

Now, look at the **STRATEGY** section. Detailed recommendations on how to proceed with the inspection are provided for the treaty monitor. Use the scroll bar on the right-hand side of the **STRATEGY** window to scroll downwards. Notice that a **Possible CS** is now indicated. This CS can be located in the **CSs** scroll box in the **Remaining Possibilities** section, and corresponding information panels with a picture and TSAMs form may be examined if desired.

*Technical note: the rule base in the program has fired a rule that caused the recommendations to display, and warned the treaty monitor about the Concealed Access CS, because the access width was narrow enough to eliminate **all the** ICMs.* For more information about the rule base, consult the main body of the ITSIP Final Report.

1.11 SAVING OR CANCELING DATA OR NOTES IN THE DIALOG BOX.

Before we leave the dialog box, there are three buttons that control the permanent recording, or erasure, of the data we have entered. The first one is the **Notes...** button. Pressing on this button brings up the **Notes Panel** (Figure D-14), a built-in notepad for the operator's use as desired. In the **Notes Panel**, the upper scroll box is titled **Previous Comments**. It is empty, because we haven't entered any comments yet. The lower scroll box, **Notes for current analysis panel**, is the one in which we can enter new annotations. Notice that a reference to the dialog box we are currently operating, **N2.9(a) - Enclosed Space or Access Measurement**, is shown. Annotations can be entered, if desired, below the current dialog box nomenclature by positioning the cursor in the blank area and clicking once. Then the comment can be typed. When the typing is complete, the added note can either be erased, by pressing the **Cancel** button, or saved, by pressing the **OK** button. In either case, the **Notes Panel** will be dismissed and the dialog box will again be displayed.

Both the **CANCEL** button and the **DONE** button will dismiss the dialog box. The difference is that the **CANCEL** button will erase the data we have entered and will revoke the effects of the program in acting upon that data (for example, elimination of ICMs or TLIs from the scroll boxes). The **DONE** button will save the currently displayed data, and it will make the effects of the program in acting upon the data permanent. These effects (for example, an eliminated ICM) will then be reflected in later dialog boxes, correctly showing the progress of the inspection. Click once on either of the two buttons desired. Note that the flowchart is again displayed. If it is desired to re-enter the dialog box again, the "forefinger" cursor must be moved to the center of the analysis box icon on the flowchart and clicked once.

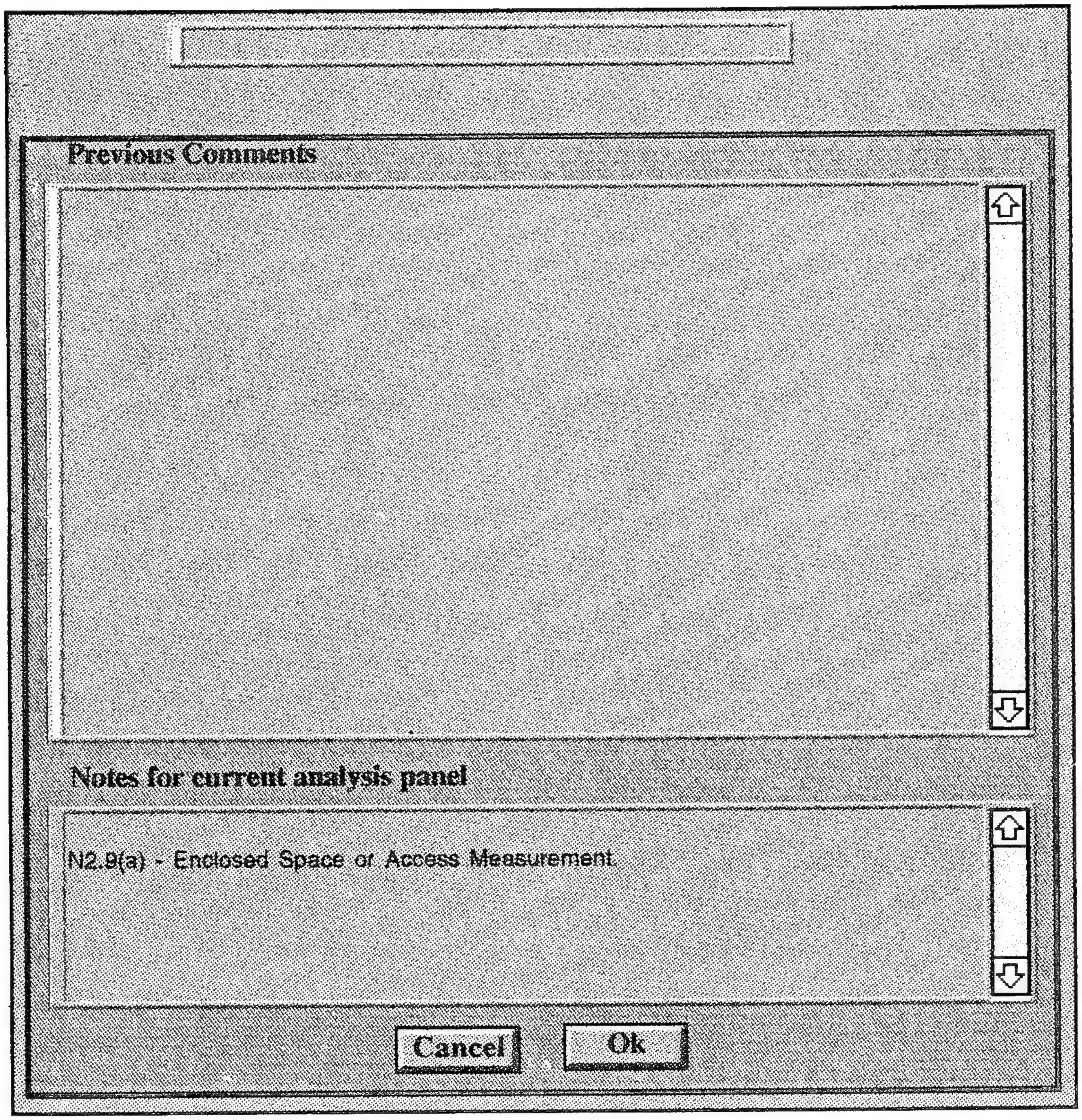


Figure D-14. Notes panel.

1.12 ADVANCED FLOWCHART NAVIGATION: OVERRIDE SWITCH AND WARNINGS.

The flowchart is designed to protect the operator against out-of-sequence steps. These include *selection of nodes before the preceding nodes have been activated, and selection of more than one answer to a decision node*. This can be demonstrated by pressing on the button adjacent to the path labeled **N4**, just to the right of the analysis box we have completed. This represents an out-of-sequence selection, since we have not yet completed the ICE decision node preceding this button. Notice that even though the button accepts the command to depress, the subsequent

analysis box does *not* turn green. Now examine the control panel, scrolling downward if necessary. The **Warnings** light has changed to red, and the adjacent numerical field shows a count of **1** warning. Now let's command another "illegal" step: selecting the **N1** button indicating a **No** answer to the first ICE decision node on Page C, even though the **N2** button, indicating a **Yes** answer, has already been selected. Again, the button accepts the command to depress, but the subsequent ICE decision node does not turn green. Also, since the analysis box below the first ICE decision node is now "party" to an ambiguous decision, it is changed back to blue again. The Warnings light remains red, and now a warnings count of **2** is displayed. Page C of the flowchart, as it appears with these "illegal" entries, is shown in Figure D-15, Flowchart Page C: Confirm That No ICM is Present in the Vehicle

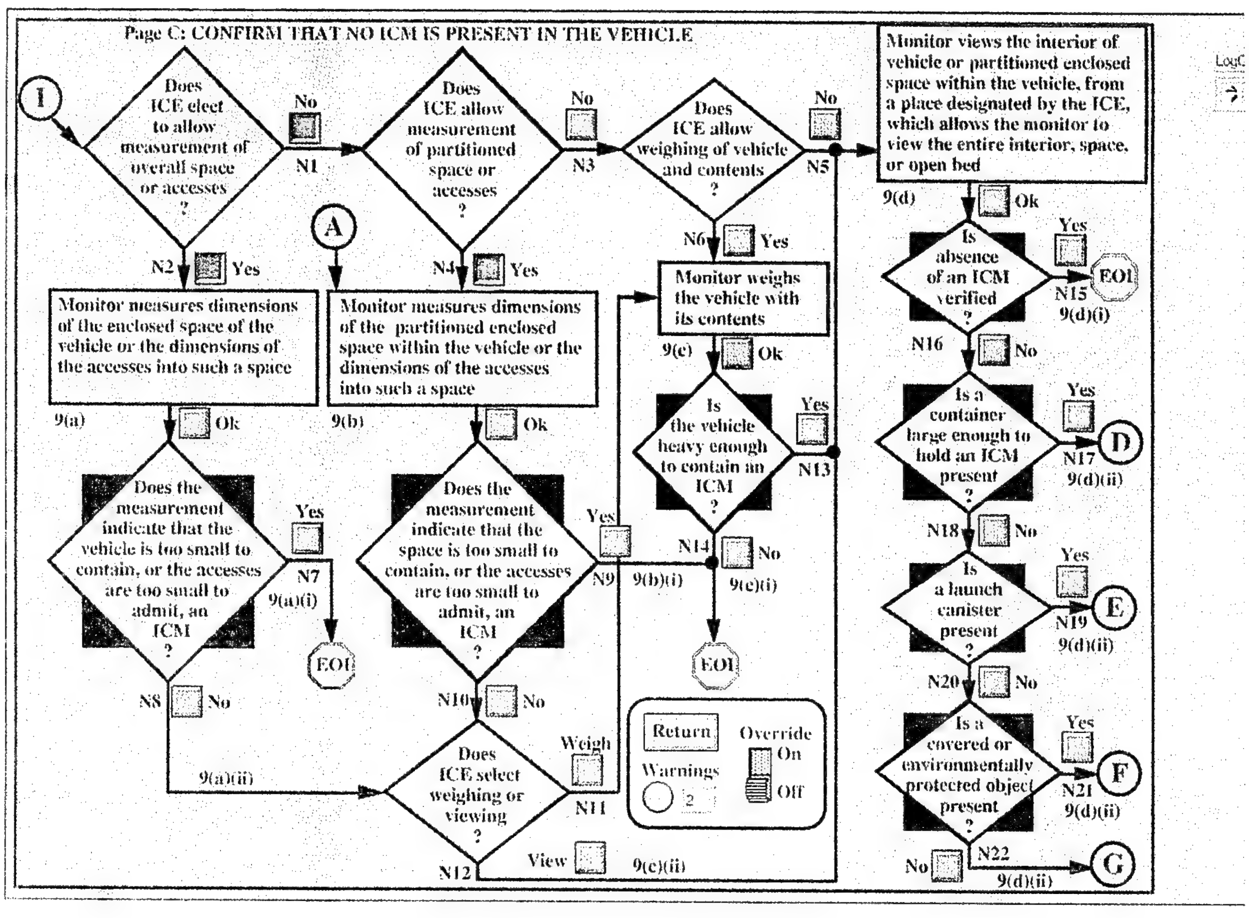


Figure D-15. Flowchart page C: confirm that no ICM is present in the vehicle.

It may sometimes be desired to deliberately execute steps of the flowchart out of sequence, and the Control Panel provides for this with the **Override** switch. Turn the switch to **On** by clicking once on the switch close to the "**On**" side. The Warnings light remains red, and the counter remains at **2**, but the program will now allow the dialog box and the ICE decision node following

the two "illegal" switches selected to be activated. The previously activated dialog box, which had been "deactivated" due to the ambiguous switch settings, is now reactivated.

1.13 SPECIAL DIALOG BOX FEATURES.

The features of each dialog box are similar to those of the one we have just examined, although the data entry sections vary slightly due to the type of data to be entered. In order to accommodate the nature of various measurements or observations, the following special control and indicator functions have been incorporated.

ICM Declaration. It is often necessary to record information about items of continuous monitoring declared by the in-country escort. For example, dialog box **P2.2** on Page A of the flowchart, **ICE Declaration**, shown in Figure D-16, requires this information. A series of pushbuttons are provided, one for each known type of ICM. To the right of the pushbuttons is a counter that is operated like the other numerical controls in ITSIP (see **Entering Data in the Dialog Boxes** for a full explanation). The counter indicates the number of ICMs of a particular type present in the railcar. The Variant pushbutton is to be pressed if the declared ICM is known to be a variant of the standard type.

A variant, for example, might be a particular form of the item suited for a particular launcher. (Although space limitations in the railcar will limit the number of items that can possibly be present, it is not straightforward to predict the maximum, due to the possibility of smaller-size variants, larger railcars, etc. The dialog box does not incorporate maximum counts for the sake of flexibility.) On the right side of the dialog box a text input field is provided for comments related to each entry line

Automatic Diameter Calculation from Circumference. It might often be more practical for a treaty monitor to measure the circumference, rather than the diameter, of a large cylindrical item like a missile stage. This situation is encountered, for example, in dialog box **Y8.7** on Page B, **Launch Canister Viewing/Measurement**. Provision was made for the program to automatically calculate the diameter from the circumference. If a number is entered in the **Circumference** field, the diameter will be automatically calculated and displayed in the **(Calculated Diameter)** indicator. This diameter will be compared to the known diameters of ICMs, and certain ICMs may be eliminated as applicable.

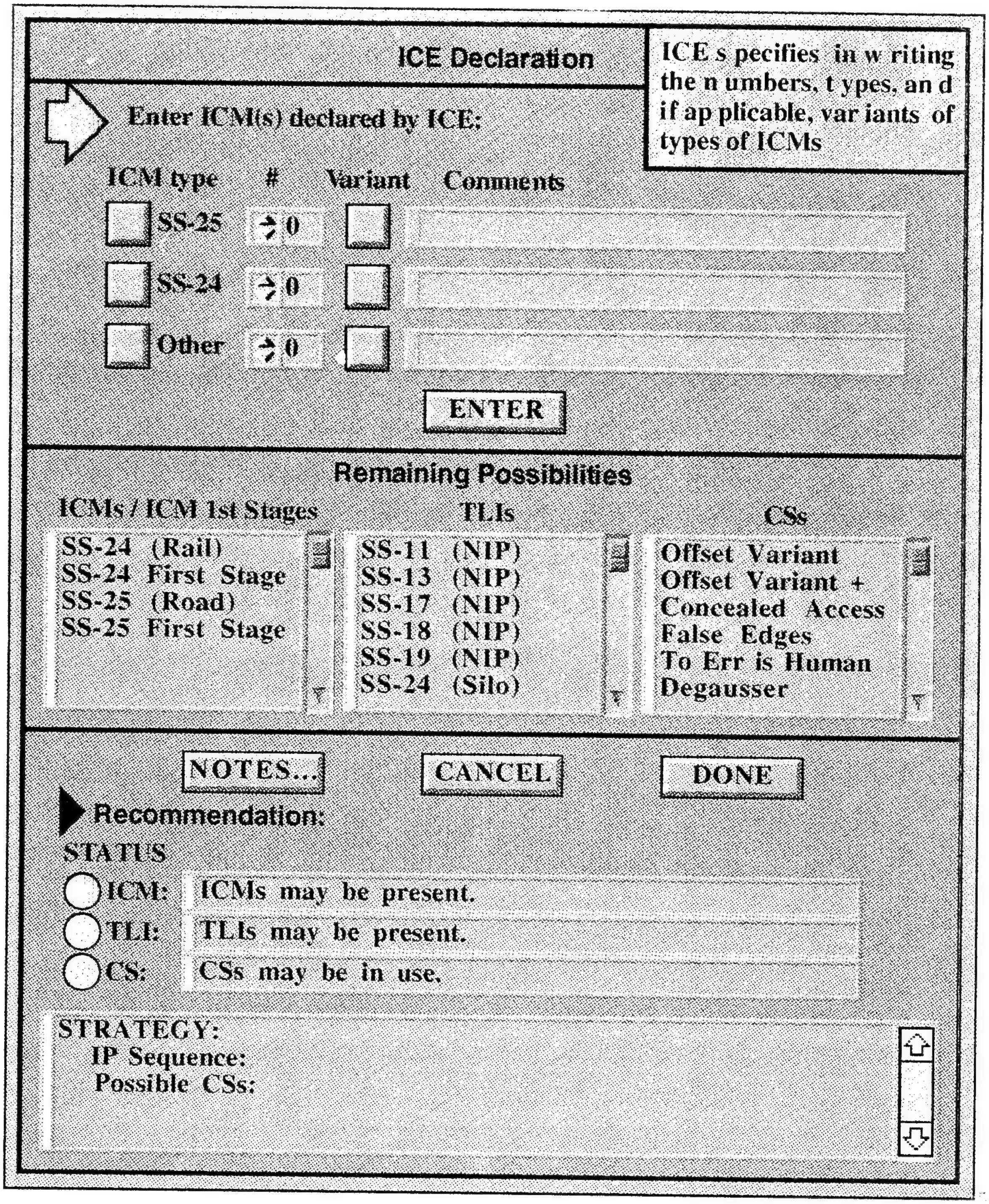


Figure D-16. ICE declaration.

Radio Buttons. Radio buttons operate like the station-selector pushbuttons on old mechanical-tuner radios. Each button is mutually exclusive with the other buttons. When it is pushed to make a selection, selections made by previous pushbutton selections are "forgotten." An example of the use of radio buttons can be seen in the data entry section of dialog box **N5.9(d)** on Page C of the flowchart, titled **Viewing of Vehicle Interior or of Interior of Partitioned**

Enclosed Space (Figure D-17). In this case the radio buttons indicate that one of five mutually exclusive observations has been made.

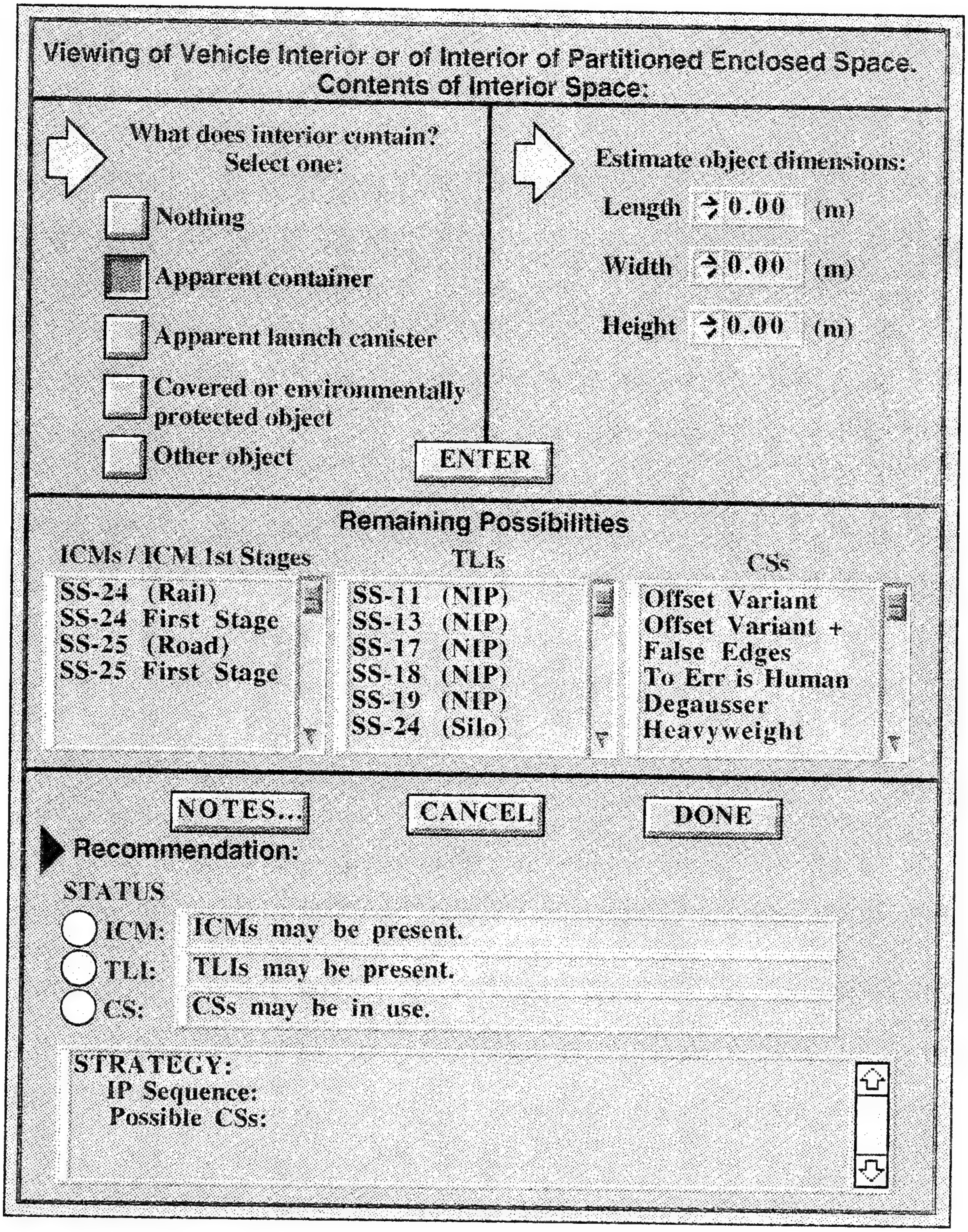


Figure D-17. Viewing of vehicle interior or of interior of partitioned enclosed space. Contents of interior space.

1.14 X-RAY SCAN INPUT AND ANALYSIS.

The X-ray data acquisition is much more involved than the acquisition and analysis of scalar weights and measures. Therefore, the dialog box is more involved. There are two instances of X-ray dialog boxes: **C5.10(d), Imaging of Container Contents** (Figure D-18), and **L3.11(c), Imaging of Launch Canister Contents**. Each dialog box allows the user to load a file containing X-ray data for further analysis in a subsequent dialog box that will be automatically called. If the X-ray scan is the first one to be examined in the dialog box, the **Load Present Scan** button is used. If it is the second or a subsequent scan, the **Load Repeat Scan** button is used. This button allows the dialog box to invoke special rules based on the use of at least two separate X-ray scans during a single measurement. The **Scan Unavailable** button is used in cases where the attempt to obtain a X-ray scan produces unusable data. After scan data is loaded, it will appear in graph format in the **X-ray scan** indicator in the upper right of the dialog box. The **Scan Status, Matches**, and **Offset (inches)** indicators indicate the results of analysis of the X-ray scan as explained below.

Upon pressing the **Load Present Scan** button, a directory dialog box appears. This standard Macintosh dialog box is used to designate the file to be used as the bottom scan file. Additional information on using a directory dialog box can be found in the *Macintosh User's Guide* for Macintosh PowerBook 160 and 180 computers. The X-ray scan is always loaded in two separate files, first a bottom scan file and then a top scan file, due to the implementation of the X-ray signal acquisition software at the Testbed for Arms Control Technology (TACT) site.

Several folders of X-ray scan files are stored in the MAC HD:ITSIP:TEST SCANS folder. In one of these folders, the DEMO_F01 folder, there are several files, all ending with the suffix "rad." For the top file, a file with the letters "TOP" embedded in the filename should be used; for the bottom file, the corresponding file with the letters "BOT" embedded in the filename is used. For example, the files DEMO4_02_BOT_B.rad and DEMO4_02_TOP_B.rad correspond. After the first file is selected, there will be a delay as the file is loaded into the software, and the directory dialog box will reappear for the selection of the top scan file. After selection of the top scan file and another delay, the top and bottom halves will appear in the **X-ray scan** indicator and the **Reference Scan Scale and Match** Dialog Box will be automatically called.

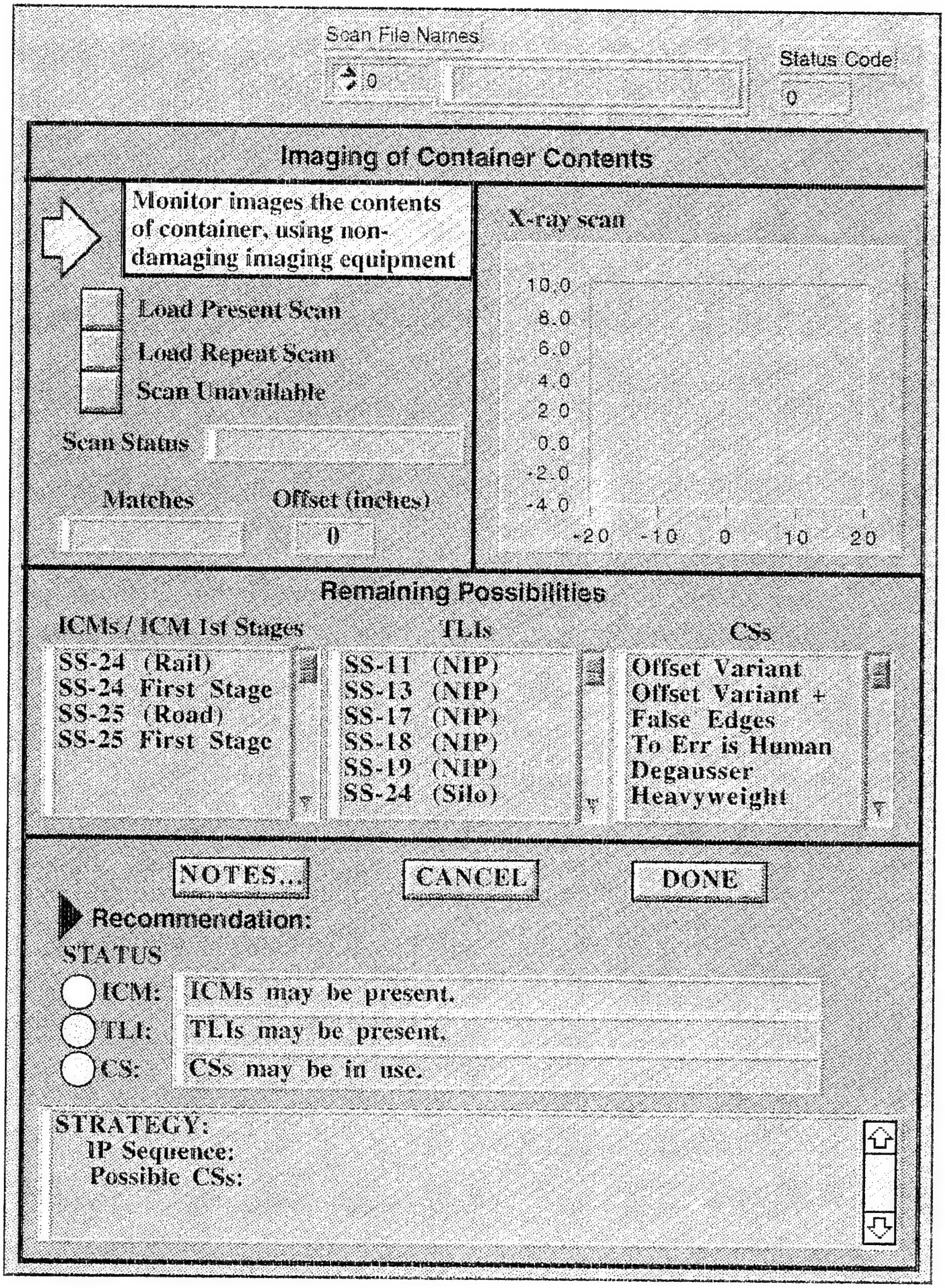


Figure D-18. Imaging of container contents.

The **Reference Scan Scale and Match** dialog box, shown in Figure D-19, perform analysis on the presently loaded top and bottom halves of the X-ray scan. It does this by sequentially loading each one of several reference scans collected before the inspection, and doing numerical point-by-point comparisons of the present and reference scans. For each reference scan, the point-by-point comparison is made at a number of different scale factors. These scale factors allow ITSIP to recognize and classify X-ray traces of ICMs that are laterally displaced in the railcar, which causes their X-ray traces to contract or expand slightly about the center. The treaty monitor can specify the extent of contraction which ITSIP will anticipate with the **Smallest Scale Factor** numerical control. Likewise, the extent of expansion is specified with the **Largest Scale Factor** control. The program will compare the present X-ray scan with the reference scan, scaled by a range of scale factors from the **Smallest Scale Factor** to the **Largest Scale Factor**. The **Scale Factor Increment** control allows the treaty monitor to specify the increment for varying the scale factor in this range.

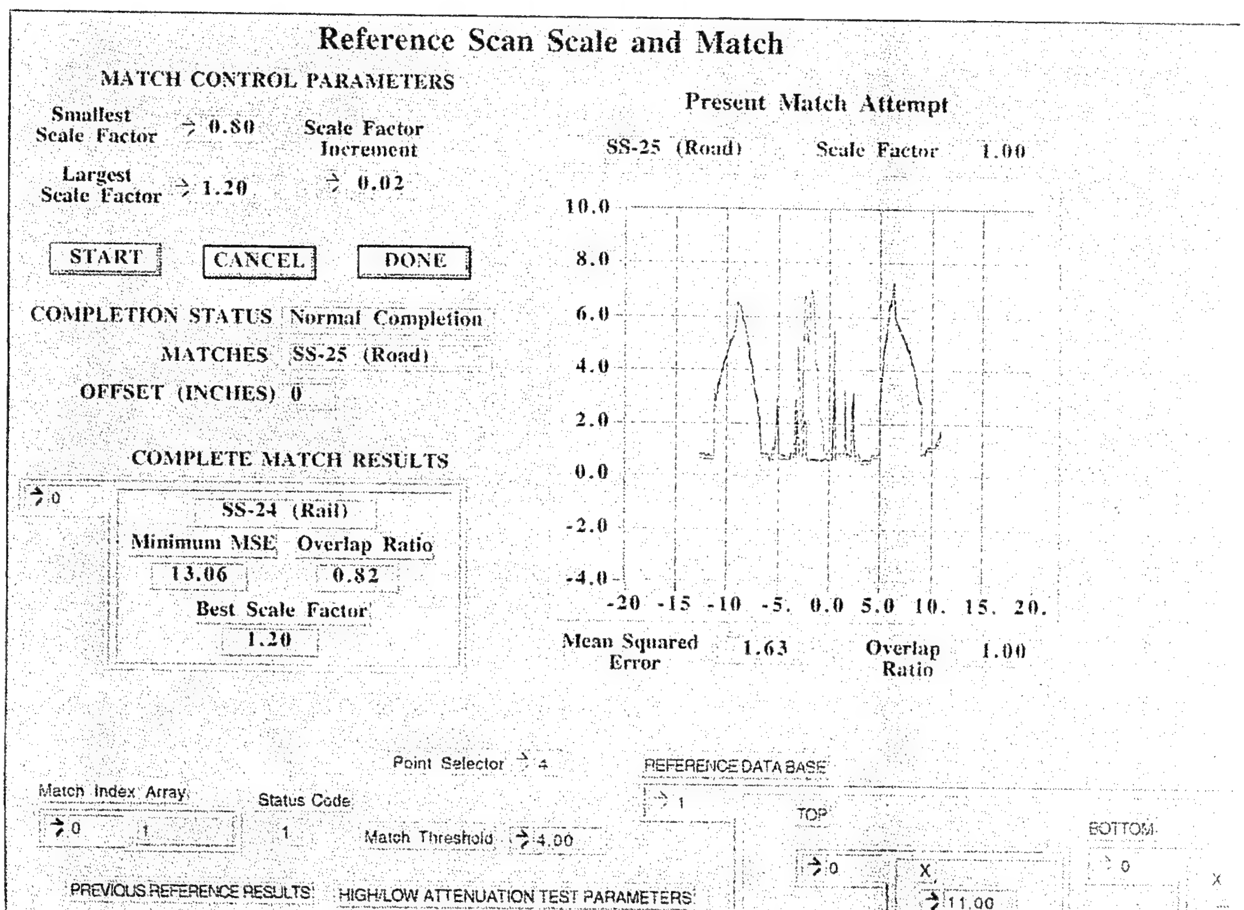


Figure D-19. Reference scan scale and match.

The match process is started by pressing the **START** button. It can be canceled anytime it is in process by pressing the **CANCEL** button. The present X-ray scan is shown in blue and the reference scan, in red on the **Present Match Attempt** graph. The various scale factors applied to the reference scan are shown by the program by re-drawing the reference curve at each scale factor. The ICM associated with the reference scan under comparison is shown above the left side of the **Present Match Attempt** graph, and the scale factor applied to the reference scan is shown in the **Scale Factor** readout above the right side of the graph. The numerical indication of match quality for each scale position is shown in the **Mean Squared Error** indicator.

After the program completes the comparison of the present scan with each reference scan, scaled by each appropriate scale factor in turn, the results are displayed in the three readouts below the **START**, **CANCEL**, and **DONE** buttons. If a suitable match is obtained for any reference scan, the corresponding scan is re-displayed in the **Present Match Attempt** graph for the examination of the treaty monitor. The **COMPLETION STATUS** readout indicates the status of the scan. The status may be *Normal Completion*, *High Attenuation*, or *Low Attenuation*. The **MATCHES** readout will display the name of any ICM for which the reference scan matched the present scan to a suitable degree of fit. The **OFFSET (INCHES)** button displays the lateral offset of the item in the railcar, as determined by the X-ray analysis. The **COMPLETE MATCH RESULTS** indicator displays the mean-squared error and other technical information determined for each reference scan.

After the treaty monitor has inspected the match results, the analysis is concluded by pressing on the **DONE** button. Then, the dialog box can be dismissed by clicking once in the small square white box at the upper left of the title bar of the dialog box. *(Technical note: this procedure for concluding and dismissing the dialog box is slightly different from that for concluding and dismissing all other dialog boxes. The difference is due to reasons of display timing peculiar to the* ***Reference Scan Scale and Match*** *dialog box.)*

When the **Reference Scan Scale and Match** dialog box have been dismissed, ITSIP will return to the Imaging of Container Contents dialog box. The **Scan Status** indicator reflects the status from the **COMPLETION STATUS** indicator of the **Reference Scan Scale and Match** dialog box. The **Matches** and **Offset (inches)** indicators are carried forward from the **Reference Scan Scale and Match** dialog box.

1.15 CONCLUDING AN INSPECTION.

When the inspection draws to a close, the flowchart will terminate on an **EOI** icon. Pressing this icon is optional and will cause the **EOI Node Panel** (Figure D-20) to appear. This panel

provides a help message for the benefit of an operator who is unfamiliar with the **EOI** icon. It is dismissed by pressing on the **OK** button.

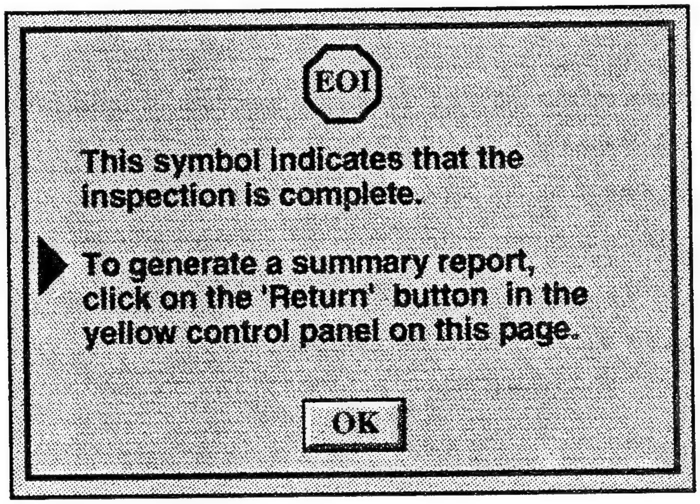


Figure D-20. End of inspection (EOI) node panel.

When the inspection has progressed to an **EOI** icon, the inspection is complete. Pressing the **RETURN** button on the present flowchart page will cause ITSIP to open the **Inspection Summary Report** dialog box, shown in Figure D-21. (The pages of the flowchart used previously will momentarily appear on the screen in reverse order before the **Inspection Summary Report** appears.) The measurements, observations, and operator comments made during the inspection will appear at the top of the **Inspection Summary Report**, along with message(s) indicating possible CSs. The **Remaining Possibilities** scroll boxes appear in the middle, and at the bottom, an area is provided for the optional entry of any post-inspection comments by the treaty monitor. The **RESUME** button will allow the inspection to be re-entered at Page A of the flowchart without loss of the present inspection data; the **CANCEL** button will end the inspection without saving the data, and the **DONE** button will allow the information to be saved before the inspection is ended. After the **DONE** button is selected, the information is saved to a file named by the user in a standard Macintosh directory dialog box. After this, (or after the **CANCEL** button is selected), the program returns to the **ITSIP System Panel**.

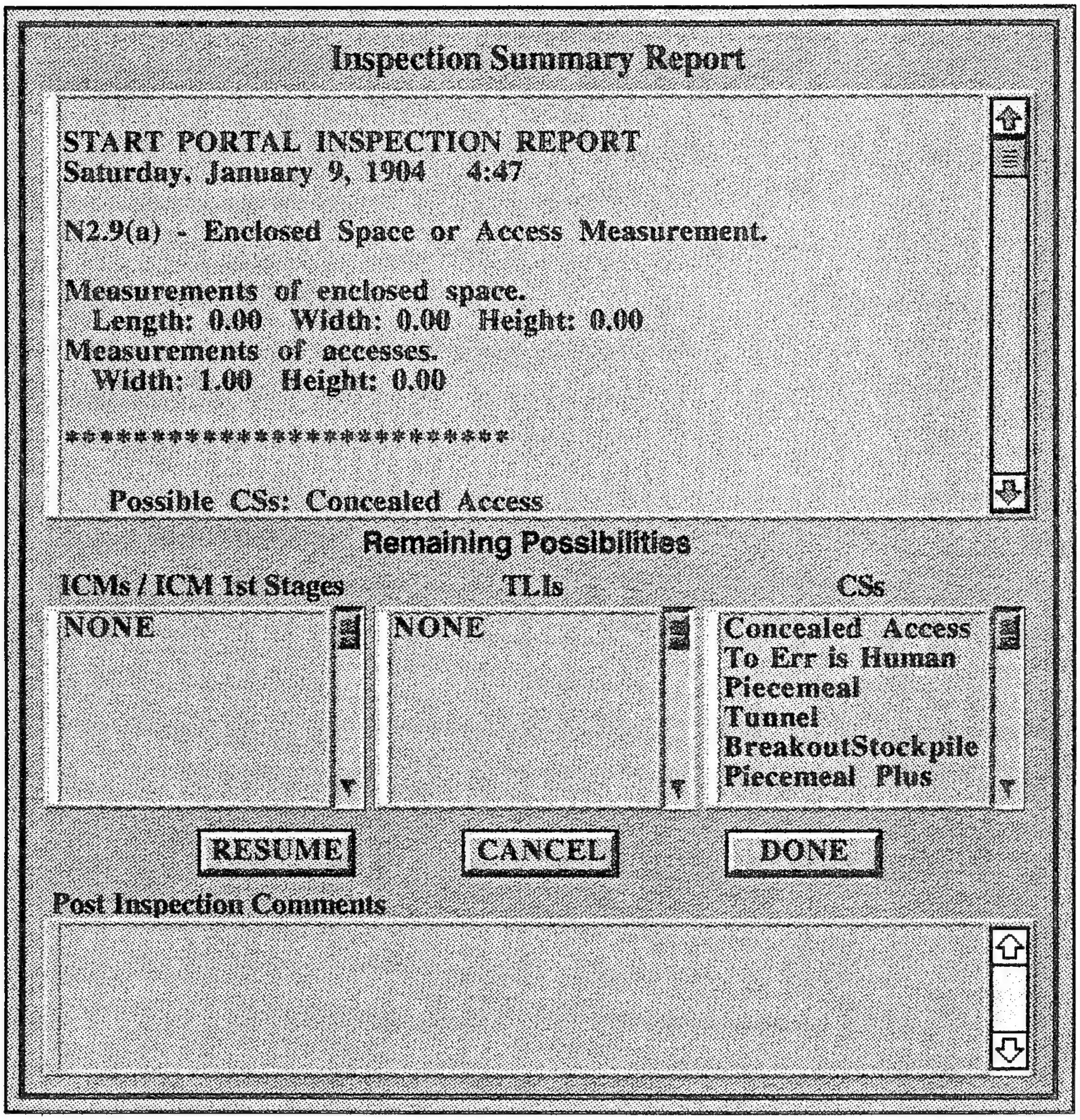


Figure D-21. Inspection summary report.

1.16 GENERAL OPERATING RECOMMENDATIONS AND PROBLEM RECOVERY.

Active Windows and Displayed Windows. ITSIP often has multiple windows on the screen at the same time. Some windows may be concealed by others, partially or completely. When the program opens a new window, the new window is "running" and can accept mouse or keyboard inputs. The other windows that may be partially or completely obscured are "frozen" and cannot accept inputs until the program passes control to them.

This usually works out fine. However, clicking on one of these "frozen" windows will cause it to be displayed on the top of the other windows, possibly hiding the window that is still active. The "frozen" window, meanwhile, will refuse to respond to mouse or keyboard commands.

If this happens, return the active window to the display by clicking on any portion of it, if any portion is visible. If not, click the mouse on the **Windows** menu item at the top of the screen, and hold the mouse button down. A list of currently present windows will be displayed in the bottom section of the three sections of the menu. (For example, the window names might be: **ITSIP MULTI-TREATY SYSTEM Panel, ITSIP System Panel, start ITSIP Panel, FlowA Panel, FlowC Panel**...) The one in the display foreground has a check mark next to it. The last window name in the list will be the active window. Holding the mouse button down, move the mouse downward until that window is highlighted, and then release the mouse button. *(Use caution when doing this, because releasing the mouse button in the top or middle section may cause additional windows to open, further complicating the situation.)* The window that had accidentally been brought to the foreground will have its position in the list changed, which may cause it to again be brought to the foreground later when it is "frozen." In this case, simply select the active window, using the above procedure.

LabVIEW Programming Menus. In this prototype system, the full functionality of LabVIEW remains available, including the ability to view and modify the program. Except for the **Close, Print**, or **Quit** items in the **File** menu, and the **Windows** menu as described above, the use of the pulldown menus is not recommended as it may result in permanent alterations to the ITSIP program. (Most of these options are disabled while ITSIP is running.) For those experimental souls who just have to try their hand at LabVIEW, a full backup of the hard disk should be performed before embarking!

Closing Windows. Close all windows (except for the **Reference Scan Scale and Match** and the **ITSIP MULTI-TREATY SYSTEM Panel**) by using the **DONE, CANCEL,** or **RETURN** buttons on the VI...not by using a close box in the window menu bar (if visible) or the **Close** item in the **File** pulldown menu (these options are generally disabled anyway). If the buttons are not visible, the display should be scrolled. The reason for this is that closing an active panel will make it impossible for ITSIP to return control to another VI. ITSIP will have to be aborted and restarted, losing the current inspection.

Waiting for Dialog Boxes. The large amount of data associated with dialog boxes causes a delay of a few seconds when one is automatically opened by the program. When selecting a path leading to an analysis node, give ITSIP time to respond. An hourglass symbol indicates that

ITSIP is doing something, and the user should (please) wait. Clicking again on the flowchart while the dialog box is opening may cause an active dialog box to be concealed by a "frozen" flowchart as described above in *Active Windows and Displayed Windows. On an active flowchart, a button selection will always change either the color of the following icon or the* ***Warnings*** *count.* If the flowchart panel is inactive, only the color of the selected button will change.

Single-clicking Buttons. Use only a single click to select buttons. A double click can have two possible effects. Either the button will be selected and deselected again before ITSIP reads it for a null result; or the button will create a new active panel and the second click (in the previously active window) brings the previous, "frozen" window to the foreground. The solution to the first outcome is simple: select the button again. In the case of the second outcome, the recovery procedure is as described above in *Active Windows and Displayed Windows.*

Selecting Numeric and Text Input Fields Before Typing. To enter data directly into these fields, select the field by clicking once or twice in it, and then enter the data. One click results in character-by-character entry at a cursor; two clicks allows overtyping of the entire field. The entered data will not be processed by ITSIP until after the user clicks the mouse button again outside of the field. Usually this is accomplished by clicking on the **ENTER** button.

Appearance of program controls. Some features' controls and indicators of the ITSIP program intended for programmer or program control use may occasionally be displayed. For example, the Start ITSIP Panel, required for proper program initialization, is not visible when the Powerbook 180 alone is used to run ITSIP, but will appear on the Powerbook 180 monitor when an external monitor is used as the primary monitor.

Additional controls and indicators will sometimes become visible if the windows are resized. (The system is provided with window sizes and positions selected for operator efficiency and simplicity, consistent with the possible use of a 13" external monitor.) The thick black-line border of each window shows the portion of the window intended for operator use. The additional controls and indicators beyond the operator area may be ignored; attempts to operate the controls may result in complications, possibly requiring termination of the program.

1.17 ADDITIONAL DEMONSTRATIONS.

The application of ITSIP techniques to two additional treaties besides START is illustrated in the ITSIP software. These illustrations are generally less fully developed than the START Treaty application, as they were developed primarily to demonstrate the utility of ITSIP to those treaties.

The two illustrations are accessed from the **Innovative Treaty Sensor Integration Project Treaty Selection** panel by using the **CWC Treaty** button or the **CTR/UN Applications** button.

The **CWC Treaty** button leads to a top-level flowchart showing the general procedures to be performed as part of a **CWC Storage Facility Inspection**. Five icons with straight tops and sides but curved bottoms are present. Clicking the mouse buttons in any of these icons causes a flowchart window to be opened which contains detailed procedures that implement the general procedure indicated. In all cases except the **Munition NDE** icon, the flowcharts are provided for viewing only and are not operable. Clicking on the **OK** button on each chart will return control to the **Innovative Treaty Sensor Integration Project Treaty Selection** panel.

The **Munition NDE** panel contains a flowchart which is operable. This flowchart can be started by clicking on the round off-page connector labeled **D** at the top left of the panel. The flowchart is operated in the same way as the **START** flowcharts. As the user proceeds through the flowchart page, dialog boxes will automatically open at the analysis nodes, and help boxes can optionally be opened at the decision nodes. This page of the flowchart can be exited at any time by clicking on the **Return** button in the control panel. This is the same as the behavior of the START flowcharts.

Several differences, however, will be apparent in the dialog and help boxes. The three scroll boxes presented in the **Remaining Possibilities** area in the START dialog boxes are replaced by two scroll boxes labeled **Inspection Objectives** and **CSs** in an area titled **Verification Information**. The **STATUS** indicators in the bottom **Recommendation** section have been changed accordingly. Clicking on any of the **CSs** will open up a template describing the technique; clicking on the **OK** button will dismiss the template. Clicking on any of the **Inspection Objectives** will open a titled declaration window symbolic of data retrieval; clicking on the **OK** button will dismiss the window. The single scroll box in he help boxes is titled **Remaining Inspection Objectives.** These changes reflect the different approach used in development of the software due to differences in the treaties. In the Acoustic NDE and Neutron Activation testing, the data displayed in the graphs and indicators is hypothetical data only and is not related to any actual measurements. Also, controls provided in the top data entry areas of these dialog boxes are for illustration only and are generally not operable.

To leave the **CWC Storage Facility Inspection** panel and return to the **Innovative Treaty Sensor Integration Project Treaty Selection** panel, press the elliptical END icon at the bottom right of the panel.

The **CTR / UN Applications** button opens a panel named **CTR Applications**. In this panel, either a **Declared Uranium Enrichment Facility** inspection or an **Undeclared Uranium Enrichment Facility** inspection can be selected. The Stop button on this panel returns to the main **Innovative Treaty Sensor Integration Project Treaty Selection** panel.

The **Declared Uranium Enrichment Facility** button opens a panel named **DECLARED URANIUM ENRICHMENT FACILITY INSPECTION**. In this panel, six icons lay out the general procedures to be accomplished in the inspection. Clicking on any of the second through the fifth icons will open a flowchart page showing detailed procedures corresponding to that icon. The **OK** button on each detailed flowchart page will return the program to the top-level page. The flowcharts are all provided to illustrate the conduct of an inspection only, and none are operable. Clicking on the sixth icon will end the inspection, returning the program to the **CTR Applications** panel.

The **Undeclared Uranium Enrichment Facility** button opens a panel named **IAEA INSPECTION - UNDECLARED URANIUM ENRICHMENT FACILITY**. On this panel, general categories of inspection areas are noted in the seven unconnected rectangles. Clicking on any of the top three of these rectangles will open a flowchart showing detailed procedures corresponding to that particular inspection area. None of the flowcharts is operable with the exception of one sample dialog box, discussed below. Each page has an **OK** button to return the program to me top-level page. The bottom four rectangles on the top-level page do not open flowchart pages.

On the **PLANT PROCESSING FLOOR** flowchart, accessed by clicking on the top right rectangle on the **IAEA INSPECTION - UNDECLARED URANIUM ENRICHMENT FACILITY** panel, the third icon from the left on the second line is annotated "**Note size and capacity of motors and compressors**." Clicking on this icon will open a dialog box. As in the case of the CWC inspection, the data shown in the top data entry area is hypothetical. The middle section, labeled **Verification Information**, has scroll boxes named **Inspection Objectives** and **ETs**. (ETs stands for enrichment techniques.) The **STATUS** indicators in the bottom **Recommendation** section are labeled accordingly. Clicking on any one of the items in the **ETs** scroll box will open a template describing the ET. At the bottom of the template there are two buttons. It may be necessary to scroll the panel to see them. Clicking on the button labeled **Picture...** will open up a new panel with a scanned photograph or diagram of the equipment corresponding to the ET. Click on the **OK** button to dismiss the picture and click again on the **OK** button of the template to dismiss the template.

When control is returned to the **IAEA INSPECTION - UNDECLARED URANIUM ENRICHMENT FACILITY** panel, clicking on the **OK** button will return the program to the **CTR Applications** Panel.

To close the ITSIP program, press the Stop button on the **Innovative Treaty Sensor Integration Project Treaty Selection** panel and type Command-K on the keyboard.

1.18 SYSTEM REQUIREMENTS.

The ITSIP software is designed to run on a Powerbook 180 laptop computer. A hard disk of at least 100 MB capacity is recommended, and at least 10 MB of RAM is required. Better performance will be obtained when using the full Powerbook 180 capacity of 14 MB RAM.

APPENDIX E

ACRONYMS/ABBREVIATIONS

APPENDIX E

ACRONYMS/ABBREVIATIONS

ACRONYMS/ ABBREVIATIONS	DESCRIPTION
ACA	Arms Control Association
AFB	Air Force Base
AI	artificial intelligence
AS&E	American Science and Engineering, Inc.
CCTV	closed circuit television
CFE	Conventional Forces in Europe
COTS	commercial-off-the-shelf
CS	circumvention scenario
CS	circumvention score
CT	circumvention technique
CTR	Cooperative Threat Reduction
CVR	Center for Verification Technology
CWC	Chemical Weapons Convention
DNA	Defense Nuclear Agency
DT	detection technique
EOI	End of Inspection
ET	enrichment technique
FSO	Former Soviet Union
ESD	Electronic Systems Division
FTD	Foreign Technology Division
GUI	graphical user interface
IAEA	International Atomic Energy Agency
IAW	in accordance with
ICBM	Intercontinental Ballistic Missile
ICE	In-Country Escort
ICM	Item of Continuous Monitoring
INF	Intermediate Nuclear Force(s)
IP	Inspection Protocol
ITSIP	Innovative Treaty Sensor Integration Project
IV	ITSIP Value
JINMM	Journal of the Institute of Nuclear Materials Management
Lt Col	Lieutenant Colonel
Maj	Major
MOE	measure of effectiveness
MSD	mean-squared difference
NDE	Non-Destructive Evaluation
NPT	Non-Proliferation Treaty

OPCW	Organization for the Prohibition of Chemical Weapons
OSD	Office of the Secretary of Defense
OSIA	On-Site Inspection Agency
OTA	Office of Technology Assessment
POP	proof-of-principle
PPCM	Portal and Perimeter Continuous Monitoring
PPMS	Portal and Perimeter Monitoring System
RDT&E	Research, Development, Testing and Evaluation
ROI	Region-of-Interest
SAIC	Science Applications International Corporation
SICBM	Small Intercontinental Ballistic Missile
START	Strategic Arms Reduction Treaty
S&TNF	Strategic and Theater Nuclear Forces
TACT	Testbed for Arms Control Technology
TASC	The Analytic Sciences Corporation
TLI	Treaty Limited Item
TOPS	Macintosh System 7 Operating System
TOSI	Technical On-Site Inspection
TSAM	Treaty Scenario Analysis Methodology
TV	television
TV	TOSI Value
U.S.	United States
USSR	Union of Soviet Socialist Republics
USAF	United States Air Force
VI	Virtual Instrument

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